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Several accepted ideas in the hardening of high-speed steel are seriously questioned in this first article of a series. The author shows that exceptionally high temperatures are not required, that soaking is not detrimental to toughness, and that the standard cobalt type does not require a higher hardening temperature than the tungsten type

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SELECTING AND HARDENING *High-Speed Steel*

MANY mechanics are adept in the hardening of standard tool steels at comparatively low temperatures, but an expert in the hardening of high-speed steels is rarely found. Two reasons for their rarity are the high temperatures involved and the difficulty of judging and producing these temperatures together with suitable furnace conditions. It is one thing to obtain a temperature of 2,300 deg. F. as recorded by a pyrometer, but it is an entirely different matter to obtain a uniform temperature in the hardening chamber of a furnace, and at the same time correct atmospheric conditions. Moreover, it requires experience, even with the use of a pyrometer, to tell when a high-speed steel tool has reached its hardening temperature.

Two practical examples show how large savings can be effected by a better understanding of the underlying principles governing the hardening of high-speed steels:

A certain manufacturer was using approximately 8,000 lb. of high-speed steel per year in the form of small flats to make chasers for threading cast-iron fittings. An oil-fired furnace, which was in poor operating condition, was used for hardening. Hot gases rushing through the furnace overheated the fine edges of the chaser teeth, causing crystallization, brittleness, and "soft skin." A hardening temperature of 2,350 deg. F. was used in this case, and because of brittleness and soft skin the chasers gave poor production and often broke in use.

The furnace was then rebuilt, and, with a comparatively low air pressure, a temperature of 2,250 deg. F. was obtained. By using a rich mixture of oil and air, chasers were produced entirely free from soft skin, and a Rockwell hardness of C64 was obtained on all specimens. Tools hardened in this manner lasted twice as long as previously and never broke in use. Considering the saving of 4,000 lb. of high-speed steel per year, it can be appreciated readily that this company saves a considerable amount through proper heat-treatment.

The second example concerns a manufacturer who chose from a catalog a cobalt high-speed steel to machine an acid-resisting chromium alloy steel. A threading tool about 3x1x5-in. long was made and given a preheat of about 1,600 deg. F. and a final heat of 2,325 to 2,375 deg. F., as recommended. By using maximum air pressure, both of the furnaces employed were brought up to the re-

quired temperatures in about 40 min. In this case also, the tool was found to be unsatisfactory, for it had a "soft skin" approximately 0.015 in. thick.

When a furnace is brought to heat in such a short period, the furnace walls have not reached a state of equilibrium with respect to heat conduction, with the result that an excessive supply of air and gas is necessary. Introducing a large tool causes a decided drop in temperature. In this particular case an immediate drop of about 40 deg. F. resulted. Additional air and gas were then used in an attempt to regain the correct hardening temperature but without success. The teeth began to sweat or bubble rapidly after a short period, but the

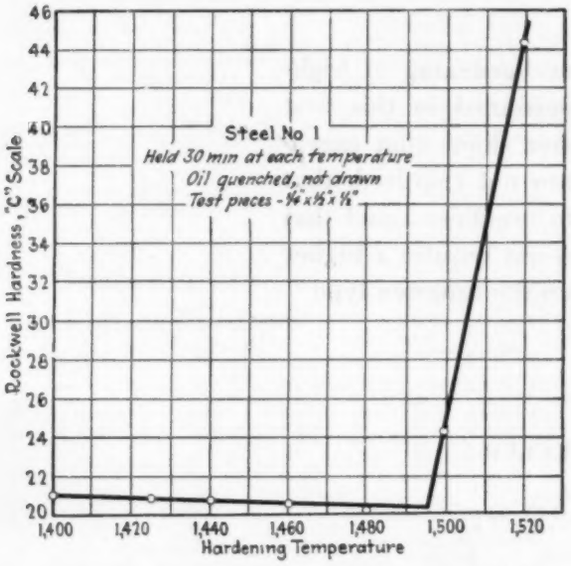

Fig. 1—This curve shows the critical range of high-speed steel

body of the tool was not up to temperature. Quenching was decided upon. After drawing for 30 min. at 1,050 deg. F., the tool was quite soft, but by grinding sufficiently the hard steel below was reached. Grinding destroys the usefulness of such a tool as a chaser, and therefore is impossible in this case.

The cause of soft skin is readily explained. High-speed steel is a comparatively poor conductor of heat. Hot gases rushing through a furnace rapidly are always hotter than the indicated temperature and bring about excessive surface heating. This causes certain mirco-constituents, such as cobalt and molybdenum, to vaporize. Any vaporization has a cooling effect, however, when cobalt high-speed steel is forced up quickly to a high temperature. It has a decided final lag and takes a comparatively long time to reach the furnace temperature. Moreover, uniform hardness throughout the tool is difficult to obtain.

Another cobalt tool was hardened by giving it a double preheat—one at 1,500 deg. F., the other at 1,800 deg. F. The hardening furnace was heated to 2,250 deg. F. over a period of 2 hr. instead of 40 min. This furnace was well insulated so that air and gas at low pressure easily maintained the required temperature. The tool was preheated at 1,500 deg. F., using a lean mixture of gas and air to form a light scale in order to protect the steel from decarburization. When heated at 1,800 deg. F. and 2,250 deg. F., a rich mixture of gas and air was used to prevent excessive scaling. Very little temperature drop occurred in the hardening furnace, and the gas and air adjustment was not altered. Little sweating was noticed under these conditions. In this case a Rockwell hardness of C64 was obtained after drawing at 1,050 deg. F. for 1 hr. and cooling in air. The tool was quite clean and showed practically no soft skin. It gave excellent satisfaction in use.

It will be shown later to be a mistaken idea that cobalt high-speed steel hardens at a higher temperature than the straight tungsten high-speed steels. The reverse is true. From the foregoing examples, it will be evident that high temperature and high air pressures cause scaling and soft skin.

Because of the varying conditions found at different plants, it is necessary for manufacturers of high-speed steel to recommend a wide variation in hardening temperatures. One manufacturer, for example, recommends a range of 2,100 to 2,400 deg. F. for the hardening of a high-speed steel containing 0.70 per cent carbon, 18 tungsten, 4 chromium and 1 vanadium. Over this range it is possible to ruin many a high-speed tool if proper judgment is not used. It becomes evident that an understanding of the effect of temperature, time, and furnace conditions on the hardness, toughness, and surface conditions of the various types of high-speed steel is a very important matter and must be understood in order to harden tools properly. One of the purposes of this article is to describe a simple method of hardening high-speed steel, which will insure satisfactory service.

Hardening Characteristics of High-Speed Steel

As a class high-speed steels contain a greater percentage of alloying metals than any other type of tool steel. Because of this fact, they are very sluggish in responding to heat-treatment, and higher temperatures are necessary to effect hardening than for carbon steels. If a standard high-speed steel containing 18 per cent tungsten, 4 chromium, and 1 vanadium be heated to 1,400 deg. F., held for 30 min. at this temperature, quenched in oil, and tested for hardness, it will be found to have decreased slightly in hardness, as shown in Fig. 1. Holding samples for 30 min. at temperatures ranging from 1,400 to 1,480 deg. F., and quenching in oil actually causes a slight annealing or reduction in hardness. But between 1,480 and 1,500 deg. F., a decided change occurs in the steel, for holding a sample the same length of time at 1,500 deg. F., causes it to increase 3½ Rockwell "C" numbers, while holding at 1,520 deg. F., causes an increase of 22½ numbers. Therefore, the critical temperature of the steel is about 1,500 deg. F. While a Rockwell hardness of C50 to C55 can be obtained at about 1,600 deg. F., it will be found necessary to use a hardening temperature of about 2,250 deg. F., to get a hardness of C64. A hardness of C66 is obtained only with a temperature of 2,350 deg. F. The reason for this is that the carbides in high-speed steel are difficult to dissolve, but once they are dissolved they form a very effective medium for hardening. Steel of Rockwell C62 cannot be touched with a sharp file. In general, however, oil quenching is preferred to air cooling, since the scale is removed by an oil quench.

For practical work, hardening temperatures of 2,200 deg. F. and over are the only ones used. There is one exception to this statement, and that is when high-speed steel is used for hot work. In this case the hardening temperature is dropped to 1,800 deg. or 1,900 deg. F. to avoid surface checking. Usually, standard hot forging steels are preferred for such purposes.

Although a gas-fired furnace can be used to good advantage for hardening high-speed steel, it is not quite accurate enough for research work. In open-fire hardening, there are certain variables, such as the rate of flow of the products of combustion, slight differences in temperature in different parts of the furnace, and others, which can be controlled accurately enough for ordinary work, but which cause variation in research work. A special method of heating was therefore decided upon to determine the effect of time and temperature on the hardness and toughness of high-speed steel.

A hole 1½ in. in diameter by 15¼ in. deep was drilled in a bar of pure nickel 3 in. in diameter by 16 in. long. This tube was placed in the furnace and blocked off with fire brick so as to leave the 1½-in. opening exposed to the atmosphere. This tube weighed about 20 lb., and when heated slowly with the furnace to the desired temperature and held there for 30 min., it formed a convenient and effective heating chamber for small samples of high-speed steel. Sufficient mass was present in the piece to prevent fluctuation in temperature, and heating was caused entirely by radiation from the walls of the tube. Nickel in itself is a good conductor of heat, and consequently a uniform distribution of temperature resulted.

In order to determine the effect of hardening temperature on high-speed steel, five representative steels were chosen of the following analyses:

Tungsten Steels

	C	*Si*	*Mn*	*W*	*Cr*	*V*
No. 1	.68	.30	.20	18	4	1
No. 2	.78	.30	.20	18	4	1.5
No. 3	.58	.30	.20	18	4	1

Cobalt Steels

	C	*Si*	*Mn*	*W*	*Cr*	*Co*	*V*	*Mo*
No. 4	.72	.30	.20	17.25	4.00	4.50	1.00	.50
No. 5	.78	.30	.20	18.00	4.00	6.75	1.85	.75

The great majority of steels on the market can be grouped into two different classes; namely, those that contain a definite percentage of cobalt as an alloying element and those that do not. The first class is often termed a cobalt high-speed steel, and usually contains 0.70 per cent carbon, 17 to 18 tungsten, 4 chromium, 4 to 5 cobalt, 1 of vanadium, and sometimes a small percentage of molybdenum. The second class, of which by far the greatest tonnage is used, is known as straight 18-4-1 tungsten high-speed steel. The carbon content of this type varies between 0.55 and 0.88 per cent, and sometimes the vanadium is increased to 1.50 per cent. Steel No. 5 in the above listing was added as a matter of possible interest. It is an expensive high-speed steel, which becomes extremely hard after treatment, but also extremely brittle. It has a limited use, but occasionally cuts well on hard or tough material.

Eight test pieces $\frac{3}{8} \times \frac{3}{8} \times 1\frac{5}{16}$ in. were prepared from each of the five steels, notched at the corners, and wired. A sample was placed in the tube, watched closely, and as soon as it faded out of view, when using yellow glasses, it was removed and quenched in oil. Whenever the temperatures were changed, the furnace was held at the new temperature for at least 30 min. before beginning to harden. Samples were drawn for one hour at 1,050 deg. F. in an electric furnace with automatic heat control and allowed to cool with the furnace. They were tested for hardness before and after grinding to be sure that soft skin was entirely removed. In this furnace even cobalt steel was hardened at temperatures as high as 2,425 deg. F., and showed only a slight indication of soft skin.

Hardness readings were plotted in a set of curves shown in Fig. 2. This illustration shows that when either a cobalt or a tungsten high-speed steel is allowed to remain in a furnace just long enough to reach the hardening temperature, its hardness will increase with the temperature at a nearly uniform rate up to 2,350 deg. F. From 2,350 to 2,425 deg. F. the rate of increase is somewhat lower. Fig. 2 also shows that both of the cobalt steels harden at a lower temperature than the straight tungsten steels. Cobalt steel No. 5, for example, when heated to 2,200 deg. F., has a hardness of C62.7, whereas the straight tungsten steels Nos. 1 and 2, have a Rockwell hardness of only C59. Even the cobalt No. 4 with its lower percentages of carbon, cobalt, and vanadium develops a hardness of C61 as compared to C59 for the tungsten steels. Apparently, the cooling effect of surface volatilization in improper heat-treatment is the cause for the belief that cobalt steels harden at a higher temperature than tungsten steels.

Time Element in Hardening High-Speed Steel

For years steel manufacturers have emphasized the point that high-speed steel should be quenched as soon as it reaches its hardening temperature, the reason for this being that grain growth with time is quite rapid at the hardening temperature of high-speed steel. The result is that if high-speed steel tools are soaked for any length of time they are apt to be brittle, besides having a poor surface condition. However, soaking is unavoidable in many cases. Hundreds of tools made of such steel have been hardened—special milling cutters, wood cutting tools, and tapered reamers—where parts of them reached the hardening temperature one or two minutes before other parts. As it is generally required to have all parts of such tools hard, soaking is unavoidable. It

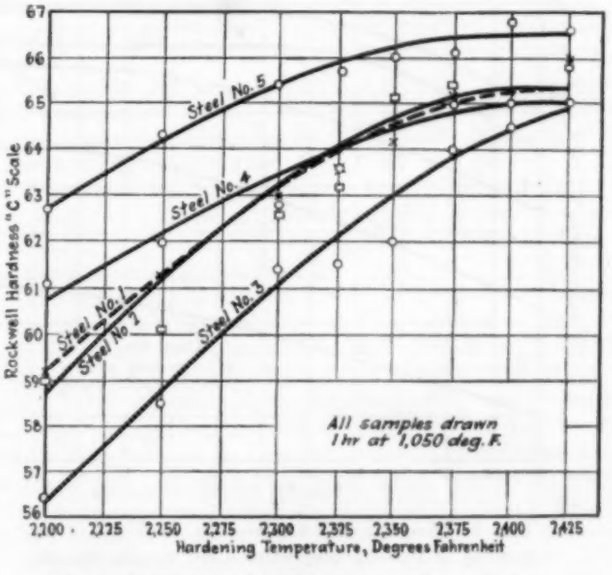

Fig. 2—Comparison is made of the hardening characteristics of three tungsten high-speed steels and two cobalt high-speed steels, showing that the latter harden at a lower temperature

is highly desirable, therefore, to know how the time that a high-speed tool is held at the hardening temperature effects the hardness, toughness, and surface condition, and to determine the combination of time and temperature that will give the best average results.

Effect of Time on Hardness

To determine the effect of time of soaking on hardness, 55 test pieces were made of steel No. 2. These pieces measured $\frac{3}{8} \times \frac{3}{8} \times \frac{5}{16}$ in., and were notched and wired. The effect of time on hardness was determined at the following temperatures: 2,100, 2,200, 2,250, 2,300, and 2,350 deg. F. Three samples were used to determine the time in seconds required to reach each of the above temperatures. Test pieces were placed directly into the nickel tube without preheating, and a stop watch was used for timing. It was found that samples reached the various temperatures in the following periods:

2,100 deg. F.—2 min., 4 sec.
2,200 deg. F.—1 min., 55 sec.
2,250 deg. F.—1 min., 52 sec.
2,300 deg. F.—1 min., 44 sec.
2,350 deg. F.—1 min., 36 sec.

The total variation in time for any three samples was not more than 2 to 3 seconds. The time recorded is the average. Samples were then soaked for different periods at the hardening temperatures by timing them with a stop watch. Referring to Fig. 3, it will be seen that at 2,100 deg. F. the soaking period is 2 min. for a sample to increase in hardness from C57 to C59.9, whereas at 2,350 deg. F. only 1 min. is required for a sample to increase from C63.5 to C66. Thus, increase of hardness with time of soaking is faster at the higher temperatures. It will also be noted that at 2,250 deg. F., an increase of hardness from C61.5 to C63.9 is effected in a soaking period of 1 min. It will be later shown that steel No. 2 when soaked for 1 min. at 2,250 deg. F., is as tough or slightly tougher than when brought up to 2,350 deg. F. and not soaked. Fig. 3 shows that they have the same hardness. Therefore, it is possible by soaking tools for one minute at 2,250 deg. F. to get the same hardness as when heated to 2,300 deg. F., without soaking, and to have as good or better physical properties. It is also important to note that hardening is under more accurate control when using a short-time soaking period at the lower temperature.

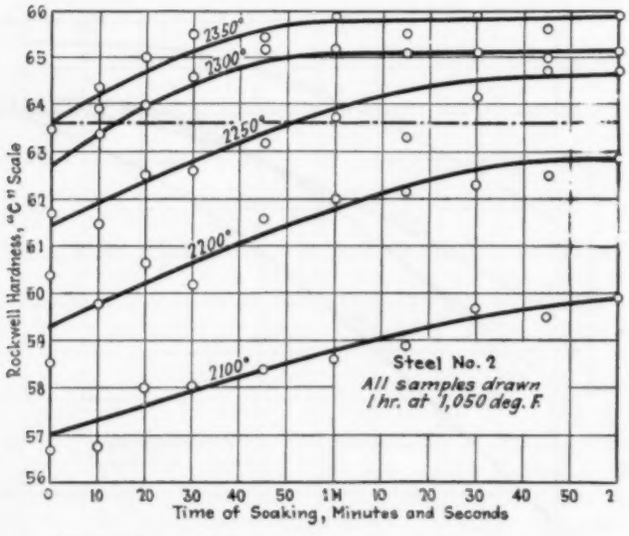

Fig. 3—Effect on the hardness of steel No. 2 by soaking at various temperatures for varying lengths of time. Better control of hardness and equal or better toughness is achieved by soaking for a longer period at lower temperature, as discussed in the next article

Although a complete set of time curves has not been developed for cobalt steel No. 4, it will be shown that a Rockwell hardness of C64 is easily obtainable by soaking from 1 to 1½ min. at 2,250 deg. F., and that this combination of time and temperature gives very desirable physical properties.

Effect of Time and Temperature on the Toughness of High-Speed Steel

It is highly desirable to have a nicely balanced combination of hardness and toughness in a high-speed-steel cutting tool. Standard high-speed steels can be hardened to a Rockwell hardness of C66, but it will be shown that such tools are more brittle than when hardened to C64. The increase in two Rockwell numbers is only obtained at a decided sacrifice of toughness. To all practical purposes a tool having a hardness of C64 will cut just as long as one of C66, and often will cut longer as the tool will maintain a keener edge because of its greater toughness. In the following article it will be shown that standard high-speed steels when properly hardened can be made remarkably tough.

Ten Commandments of Good Organization—*Discussion*

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TO M. C. Rorty's excellent decalogue on page 22, Vol. 73, there may be added as a kind of epilogue the fact that the success of such a plan depends upon the two-fold qualities of square-dealing and tact. The chief who plays the game will apportion praise and blame without favor or prejudice; the subordinate who plays the game will accept just praise or just blame without conceit or grudge. Necessary discipline will be recognized as such, and accepted by superiors and inferiors alike. On no other basis can satisfactory relations be maintained, either in shop or in office.

Square-dealing needs reinforcing by courteous common-sense, which is "tact." Certainly in this connection Mr. Rorty's contention that correction should be administered privately is most important. More bad blood is caused through merited but inconsiderate and thoughtless public correction than by almost any other means. There are always sychophants who are ready to fawn upon the fortunate and whose appetite for the life juices of the unfortunate is insatiable. These men relish nothing better than to be in at the telling-off of their immediate superiors by one still more highly placed. Tactless administration of necessary rebuke can and does defeat its avowed objective. Instead of stimulating an increased sense of responsibility, arousing a keenness to amend and improve, it oftener than not begets a resentment which festers like a septic sore, and a good executive degenerates into an active agent of discontent.

On this continent or another, often in out of the way places, even these sturdy machines break down, and repairs must be made in the field without delay. The necessary interchangeability of parts is obtained by the use of jigs in manufacturing them

Justifying Jigs *for Limited Production*

E. W. JOHNSTON
Production Manager, The Thew Shovel Company

HIGH UP in the mountains of Eastern Tennessee, a new road is being chiseled out of solid rock. A huge power shovel is eating its way for miles around the mountain side. Down in the center of a nearby town we find another monster, watched by an admiring audience, digging and battering a ditch also through solid rock.

Back of these mechanical giants we find a story that is as interesting as the actions of the machine itself. In this day and age we can best make our comparisons with the automobile, as it is an integral part of our everyday life. How well we know what happens when impact is brought to bear upon our means of conveyance. Should we run into a telephone pole we send for the wrecking car. If we run into a hole or rut we are likely to break a spring. If we abuse our machine we expect a bill from our garage man.

But how different with these rugged shovels. Impact is their daily grind, climbing into holes and out again their duty. Abuse seems to be the dominating factor in their effort to produce for their owners. They only earn while in operation, therefore, they must not stand idle.

As inevitable as sickness to humans, there may come to these monsters a tremendous sudden shock. The very power that makes them so mighty that they do not yield to overtaxation can cause their own destruction. These machines can be broken.

A sudden accident, or the ever-present abrasion and wear, has caused a major part on the shovel, high up the mountain side, to fail. A telegraphic order is started on its way to order another part. The broken part is dismantled and everything is ready for the new one coming from the factory. It arrives, and in three hours is put in place. The shovel is again ready for service.

Not a slip has occurred in the assembly of the new unit in the old machine. Everything fitted together perfectly, capable of being done readily in the field with the limited facilities available.

As a result a satisfied customer goes on his way, never thinking for a moment of the engineering and production background which has made such interchangeability of parts possible in the field.

Of course, if questioned, and if of a mechanical turn of mind, he'd probably answer that such interchangeability of parts was obtained through the use of jigs and fixtures. And, under the cover of the typical "hard-boiled" attitude assumed by the contracting trade, would say that he expected such interchangeability of parts and didn't care how it was made possible. Someone else, realizing that he did expect such interchangeability, has had to worry about making it possible, which again brings up the use of jigs and fixtures.

The use of jigs and fixtures, to obtain uniformity of parts for quick assembly and for later interchangeability is an old story. But this principle is most usually applied where the high cost of jigging-up is readily absorbed by the production volume. In the manufacture of heavy-

duty excavating shovels, cranes, and draglines, some of which weigh as much as 120,000 lb. each, the production, in actual number of units, is relatively small.

Engineers and designers of these excavators can specify the most accurate limits and dimensions. It is one thing to specify. It is another thing to get. If they do get what they specify they must be backed up by a methodical, careful, and accurate system of doing the work.

The only definite method of making two parts exactly alike is to eliminate all possible chance for error. To measure by hand means to run the chance of error. To measure by mechanical tools is exacting. In the manufacture of duplicate parts for the shovels jigs are made for holding the work and for guiding the cutting tools so that the operations on each subsequent piece shall be the same as the preceding one.

The shovel parts are large, heavy, and bulky, the machining is of an extensive nature, and the machine tools themselves are of a size to handle the part. If the part being machined is large, then the jig or fixture must be in proportion. Large, expensive jigs are the result, while the number of units over which such an enormous cost can be distributed is relatively small.

In founding its revised production policies in 1925, concurrent with the development of the Lorain line of ½- to 1½-yd. shovels, cranes, draglines, skimmers, and backdiggers, The Thew Shovel Company had these problems to face. The use of jigs would simplify the production and assembly job, but the savings in cost, versus the cost of jigs, was not sufficient to make the decision on purely an economic basis.

Thinking of the customer, and knowing what he wanted to do with the machine, how and where he was going to use it, provided the justification for making this expenditure, which was already desirable from a straight manufacturing viewpoint.

When Breaks Occur

These large, bulky shovels are used all over the world, often in very remote locations where the shovel represents practically the only machinery in the locality. These machines are worked under conditions where every idle hour on the job represents a loss of money.

Although every possible precaution is taken in the design, choice of materials, and construction of the machine, breakage and repairs are inevitable. When breaks occur, repairs must be made in the least possible time, with the least effort. To insure this quick field interchangeability of parts, all machining operations are accomplished through the use of jigs and fixtures, and are accurately inspected by checking jigs and fixtures.

Typical shop operations, involving the use of large, costly jigs and fixtures are shown in the illustrations, together with a typical view of a machine in operation, showing the conditions under which quick interchangeability of parts must often be effected. The jigs and fixtures used have been worked out, in most cases, in co-operation with the engineers of the Cleveland Tool and Jig Co.

In Fig. 1 a Carlton radial drill press is pictured drilling a steel, double-annealed, rotating base casting for a 1-yd.-capacity Lorain-55 shovel. The size of the casting is approximately 6 ft. 7 in. x 4 ft. 2 in., weighs 2,900 lb., and requires the drilling of 45 holes, varying from ¼-in. diameter up to 6½-in. diameter, all of which are drilled through a jig weighing over 5,000 pounds.

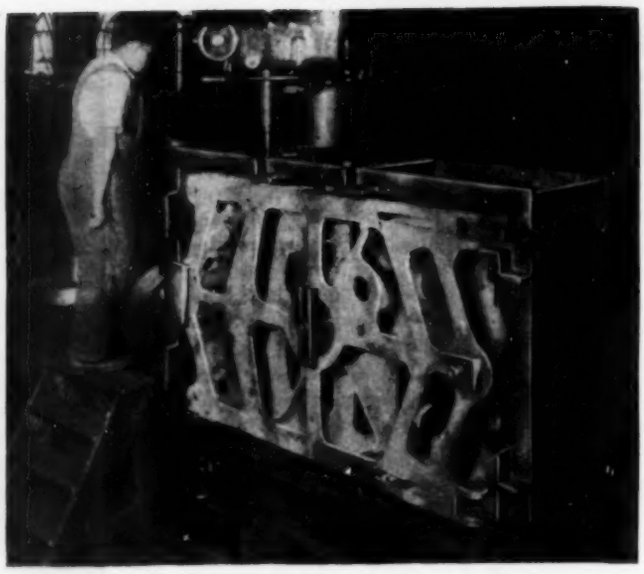


Fig. 1—The jig for this 2,900-lb. casting weighs two and a half tons

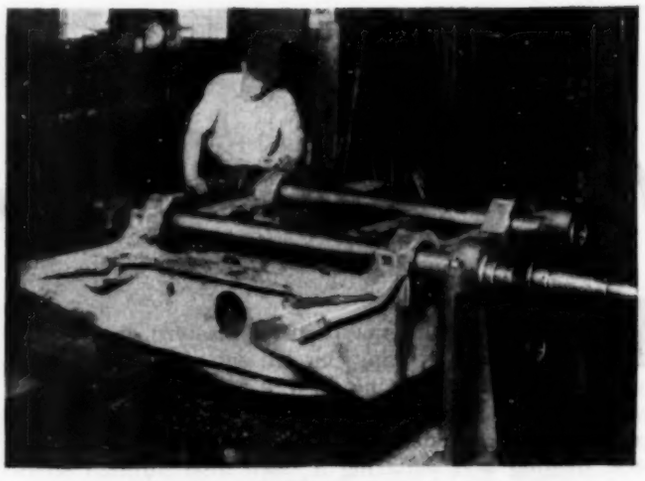


Fig. 2—Good will of the customer is the justification for jigs such as this

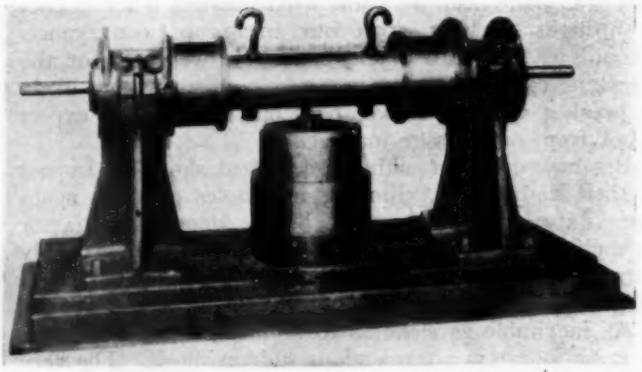


Fig. 3—A 5-ton fixture for testing turntable gears. A heavy and costly fixture for a simple operation

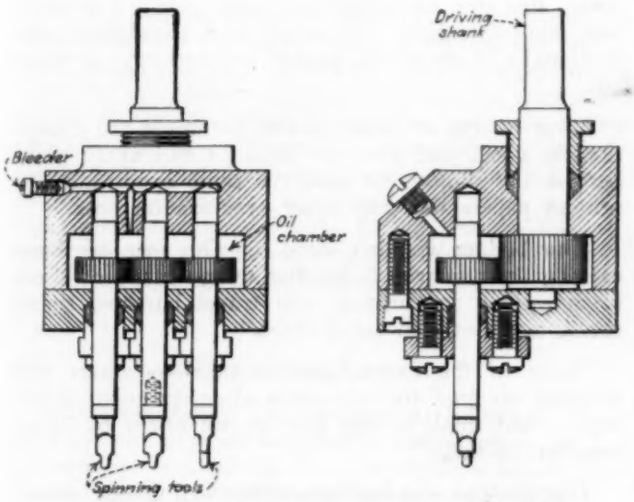
In another view, Fig. 2, holes are being bored in a single-piece steel casting which serves as the crawler car body on top of which the turntable is mounted. In this case the boring is for the two central through axles of 6½-in. diameter. This casting is approximately 10 ft. x 5 ft. 3 in. and weighs 5,760 lb. In this case, in particular, the difficulties of replacement of parts can be well appreciated. The two axles mentioned help support the entire unit, which weighs approximately 85,000 lb. With all this weight on top of the crawler, complete interchangeability of parts is a necessity and can only be obtained through the accuracy and uniformity afforded by the extensive use of jigs and fixtures.

The use of jigs and fixtures is not restricted to maintaining manufacturing uniformity, but extensive use is also made of checking jigs and fixtures to further insure uniformity and correctness—checking jigs and fixtures make up part of the 89 inspections and tests to which Lorain machines are subjected before shipment. Typical of these is Fig. 3. By means of this fixture, bevel gears for the travel and swing assemblies are checked for accuracy. The two bevels for the horizontal shaft are mounted on the horizontal spindle, at the exact distance apart. These are then rolled against a master bevel gear mounted on the vertical shaft. Vice versa, the vertical shaft bevel gears are rolled for accuracy and backlash against masters on the horizontal spindle.

Thus, in the background of romance surrounding dirt-moving, the good-will and satisfaction of Lorain owners has been built up, and through this has resulted additional installations, a result which indirectly justified the use of the jig layout, and carried their expense.

Ideas Have To Be Sold

F. J. CAVANAGH



Hydraulic device for spinning three tubular rivets simultaneously

MORE than the mere statement of an inventor's idea is required to insure its serious consideration by a manufacturer. Its worth must be impressed upon the prospective purchaser. The inventor needs to take advantage of every factor that will influence the sale of his idea, and the most effective move in this direction is to make the idea thoroughly practical. It should be remembered also that the preparation of an idea for presentation to a patent attorney often determines the ultimate value of the patent issued, for the attorney makes his irrevocable presentation of the case to the government upon his first impressions. The attorney is assisted in making an adequate statement of the case if the inventor gives him the clearest possible picture of his invention.

To illustrate the value of proper presentation of an idea, an actual case may be cited. It relates to a company which regularly used large quantities of tubular rivets that were spun, one at a time, into certain parts of its product. An employee suggested that they "provide a tool which will spin two or more rivets at a time by utilizing a hydraulic equalizer which will compensate for the varying thicknesses of material." This man had clearly visualized "a hydraulic equalizer," but he did not deem it necessary to illustrate or further describe it. The suggestion was rejected upon the ground that any form of oil or water chamber on the spinning machine would cause trouble and contribute toward an untidy condition. But an official, who realized that the suggestion came from a capable fellow, followed up the matter, and assisted the inventor to present his idea in the form shown in the accompanying sketch, with the result that the device was tried out and proved to be a time saver.

Countless valuable inspirations go into the discard for want of a little smoothing out and dressing up, so to speak. Nobody else can perform this service so well as the man who knows enough about the subject to evolve the progressive thought. Many mechanics with bumps of originality feel handicapped by their inability to draw, but this disadvantage can be overcome.

Inventions need study from all angles, especially from the manufacturer's standpoint. Every feature which will add to saleability, facilitate production or simplify operation, should be incorporated. In so doing many features are developed which may spell the difference between success and failure, and frequently a new mechanism is evolved which entirely supersedes the first conception. Anybody who presents a manufacturer with an attractive but undeveloped idea, which simply serves to stimulate a more methodical man to action, cannot consistently complain of being double-crossed if an entirely new and better device for accomplishing the same purpose results.

■

Circular Form Cutter Design—*Correction*

In an article by James L. Ingalls, *AM*—Vol. 74, page 530, Formula 2 was given incorrectly. This formula should read:

$$\text{Number of Teeth} = \frac{\text{outside diameter} \times 3.14}{\text{depth of gash} \times 1.5}$$

EXECUTIVE FORUM

Why Conventions?

J. J. MASFIELD, President of the Masfield Foundry & Machine Company, looked up from the budget he was studying to meet the eyes of Thomas McMurray, his Works Manager.

"Sit down," he said briefly. "I called you in to ask about this expense item, Memberships, Conventions, and Exhibits—$5,000. Even though you checked every item as it went through and I O.K.'d the major ones, I'm convinced that this is too steep, particularly when I'm forced to recommend a thirty per cent dividend reduction. Five thousand is ten cents a share on the 50,000 shares outstanding. Do we get value received?"

"Yes," replied McMurray. "We develop contacts that may become sales leads. Our men meet others in similar positions and exchange views. Then there's the opportunity for co-operative market research and development, training courses, and the advertising we get from exhibitions."

"Admitting that we get some of those things, I'm inclined to think that much of the proposed market study never materializes. Further, the $5,000 does not include the greater costs of men's absence from the plant, preparing and handling exhibits, and a dozen other things. The contacts are of value principally to the individual."

"But anything gained by an individual is gained for the organization."

"That's the theory, but I doubt it. Most of them are future job possibilities. As for the meetings, how much convention time is taken up with many-adjectived annual reports, predetermined elections, humorous speeches, and banquets. And why are so many so-called business meetings held in Canada?"

"Canada is defensible only from the social angle," replied McMurray. "But you'll have to admit that the personal side is most important in sales effort. Every contact we make outside, no matter how unimportant it seems, is a means of advertising and perhaps a potential sale."

"I've heard that theory before. I suppose your argument holds also for the expenses incurred in having convention exhibits, eh?"

"Exhibits help us get our products before the user at the time when he is most inclined to listen, when he is away from the care and worry of the shop."

"I believe that our best contacts are made in having what a prospect wants ready for him when he realizes he wants it," said Masfield, "and that is certainly not at conventions. Some organizations seem planned for nothing but annual shows and the publication of periodicals loaded with member advertising. Where does it all go? Fees are no less from year to year."

"You couldn't expect the periodicals to be other than self-supporting, could you? And they give you access to the entire membership—a rather select group. The shows are planned merely as a service."

"They take the time of paid officers from other duties that are far more important. And I wonder how many members read society and association publications? Many of the papers are antiques, or plain ads."

"That is true of some papers, but some are exceptionally good, and give me things I can apply right here in the shop. We have the same opportunity to present papers that any other organization does."

"Our budget wouldn't stand it. Our men are busy earning their salaries. Another thing—many of these organizations are turning into travel bureaus, sightseeing agencies, and social clubs."

"Most of the extras planned by associations and societies are just for relaxation after strenuous meetings. And think of the prestige we attain by being members of them."

That prestige idea has been rather well driven home," said Masfield, "but I fail to see its practical worth."

■

What Do You Think About This Problem?

Societies and associations have become well established elements in our present-day industrial life. Are their functions still what they were originally planned to be? Have we become a nation of "joiners," giving time and money to any and every association? Where should the function of the association or society end? How much is a company justified in expending for this item?

. . . Discussion

of Executive Problems

■

Who Buys?

Purchasing functions best when established as an independent department. As such it must not become too arbitrary, but rather it should function with a due appreciation of the specialized knowledge of other departments such as engineering and production and freely consult them for technical advice.

By creating the purchasing function independently, no one department with a particular viewpoint can force it upon others to their detriment. If specifications are used for purchasing and they are desirable, engineering can be charged with their preparation, but any questions which may involve shop processing should be referred to production. One of the most important links is a proper inspection department. Any deviations from specification should be prompt cause for rejection — involving either an ultimate waiver from engineering or production, or a revision of specification. —A. A. CROWELL.

Misguided Loyalty?

A man's first duty is to the company he serves. Being loyal to your superior officer or to fellow employees may get you into trouble. On the other hand, it is not necessary to run to the head of the company with tales.

When I first started to work a mistake was made in a measurement by my superior officer. Later on the superintendent noticed the mistake. I tried to shield my superior to my sorrow as I found out later he had placed the blame on me.

J. WALTER WRIGHT, *Assistant to the President, Wilmot Fleming Iron & Steel Company.*

Each official depends to a great extent upon his assistants to carry on his plan of procedure. This support should not be based on personal feelings, but should be an automatic function of co-operation. No subordinate can voice criticism of his superior without creating a loss of co-operation between the two and the company loses more than it realizes.

If criticism must come, it should come from the critized official's superior, and if information concerning an official is sought from his subordinate, it would seem to imply a lack of frank sincerity on the part of the questioner. When any official step is not started and completed in an open and frank manner, efficiency erosion begins and such erosion is not always easy to eliminate. —JAMES L. INGALLS, *Ingalls' Engineering Service.*

Convenience or Confusion?

Every innovation invariably meets with resistance from many sides, even though its advantages are plainly obvious; such is the nature of man. The metric system is incomparably more convenient and simple than the English system.

The scientists and engineers in the laboratory have chosen to use the metric system not because of their desire to be different from the man in the shop, but because as investigators, they have found it to be simple, logical, and correlated. As for the man in the shop, the writer has had experience in manufacturing in both systems and feels that the average mechanic likes the metric, having once become acquainted with it. There would be infinitely less confusion in changing from one system to the other than is imagined. —GEORGE BELBES, *Teletype Corporation.*

If anyone really wants to reform our system of weights and measures, the place to start is with the method of counting. Why have just ten digits? There is no merit to the number ten. I prefer eight, because then eighths and sixty-fourths would be straight decimals. If we are to count by tens, we should have a system of weights and measures which also go by tens, but there are objections to the metric system as it stands, the worst objection being the names of the units. It is all right for the electrical engineer to talk of his kilovolts, kilowatts, and kilocycles, but when we try to put kilometers and kilograms into common language it is too much. Then consider measures of length, kilometers and millimeters, hectometers, miriameters, centimeters, decameters, centimeters, and diameters. But there are some places where the metric system should be adopted to make things more clear. Is it reasonable for an automobile to go further on a gallon of gas in England than it does in America, because in England the gallon is bigger? Is it reasonable for a pound of gold to be lighter than a pound of lead, while an ounce of gold is heavier. The only way to know what you are getting with our present system of weights and measures is to know the customs of the particular trade and the particular locality in which the purchase is made.

Possibly the easiest change would be to do away with the unit horsepower. Everyone knows the kilowatt, which equals 1⅓ horsepower. Who would not be just as well pleased to drive a 30 kilowatt automobile as a 40 horsepower? The kilowatt is closely related to the electrical units and through them to all the metric system, while the horsepower has no close relation with anything, not even with the horse. —A. W. FORBES, *Forbes & Myers.*

Sales Per Schedule

Given sound control at the head, sales effort can be made more effective by directing it at prospects definitely picked. Haphazard calling is largely a waste of time which could be better spent in rendering better service to known buyers. With good staff work, the salesman can be provided with very full information regarding his prospects, and so armed, he will be able to make contact more quickly and surely. Many salesmen have but only a vague idea of the use to which different firms

may put their products. Experience has convinced me that a policy of sending salesmen to do business without all the possible points of contact and appeals for the particular prospect in view, will never succeed against competitors who prepare lists of potentially valuable customers. They prepare the way for an interview by mail and then send the salesman forward with a knowledge of the sales opportunity and an indication of what weapons of salesmanship he is likely to find most effective.

—S. A. KNIGHT,
Irak Petroleum Company,
Tuz Khurmatu, Irak.

Brain Fag

Today, the average employee has more privileges than he had in the past, including shorter working hours and better working conditions. The shop and office in most works have been renovated with up-to-date lighting and heating systems together with proper ventilation, making them hygienic and fit for all employees to work in. If a man is interested in his job, and is working under favorable conditions, an eight to ten hour day should not fatigue him. Practically everybody relaxes slightly, probably unobserved, at certain intervals during the day. Fatigue is more likely to be caused by a man not knowing his job or by the life he lives after working hours. If a man has his normal sleep, good food, and recreation and does not let his job get the better of him, he will never become really fatigued toward the end of the day.

When a man is on production work, there is a tendency for the job to become monotonous which increases the possibility of his becoming fatigued. It is difficult to say whether a ten minute break in the morning and afternoon would increase production or produce better work.

—T. R. SILVER,
Birmingham, England.

A designer of genius can often get ideas that will advance the job in hand more quickly while taking a walk than when wearing out his elbows leaning over a drawing board. His work is creative as distinguished from productive. In common with all other creative workers, he can work at his best only when in the mood, and can produce only a mediocre piece of work when he is glued to the job for a definite number of hours a day. The man who is simply putting preconceived ideas on paper can perhaps work without rest periods, but it is doubtful whether he will be at maximum efficiency all the time.

Get a good designer whom you can trust and let him do practically what he likes, even if it involves letting him disappear for an hour or two occasionally. I know it sounds a bit philanthropic, but a study of human nature will prove it to be the right method of getting output and quality.

—HARRY SHAW, *Consulting Engineer,*
Heywood, England.

No Change

Manufacturers, who are having so much trouble with labor turnover and who propose to enter into an agreement whereby each one would be bound to refuse to employ a man leaving one of the others, are trying to avoid the effects of an evil instead of trying to cure the cause. If employees are milling around from plant to plant, something is wrong with the working conditions.

What can be done in the way of attracting and holding employees is illustrated by a well known machine tool manufacturer. This concern purchased a machine from the manufacturer of a different line and two men were sent to see that it was properly installed. These men were so favorably impressed by working conditions that when the machine was operating to capacity and they were ready to return home, they asked for employment. Every possible effort was made to dissuade them, but they knew what they wanted and were finally employed. Shortly thereafter, a scorching letter came from their former employer expressing his opinion of a machine tool manufacturer who would hire men away from another. The gist of the reply was, "If you make conditions right, no one can take a man away from you. You are welcome to all of our employees that you can get." This is something to think about instead of wasting time trying to curtail a man's right to work where he chooses.

—C. J. MORRISON, *Consulting Engineer,*
Meyer, Morrison & Company.

We would vote against the resolution denying employment to men who quit without just cause. There should be no restriction placed on a workman's choice of employer. If a workman is dissatisfied, it certainly will not help anybody to try to make him stay. Most dissatisfaction is caused by the belief he can get more money at another plant. There should be an agreement in every city against hiring men from plants in the vicinity without first getting in touch with the former employer. It has been proven time and again it does not pay the employer to steal men from the vicinity, as it forces everybody to raise their wage rates beyond the normal figure. This is the cause of all the trouble.

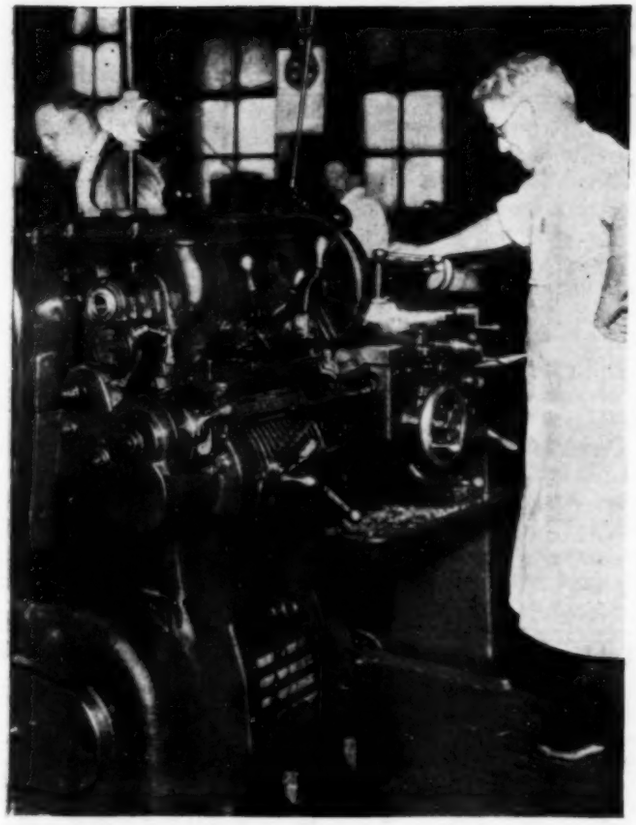
—U. SETH EBERHARDT, *Works Manager,*
Newark Gear Cutting Machine Company.

Come Seven?

It is evident that mechanical production is displacing an increasing number of workers and contributing recruits to the army of unemployed. Even in periods of prosperity this goes on. A reduction in hours of labor is inevitable if unemployment is to be held within bounds. If the seven hour day was put into force in the very near future, costs would certainly be higher to maintain the same standard of living for the worker, but we soon would evolve new methods to reduce these costs, just as we have in the past.

The extra hours of leisure, intelligently utilized, would undoubtedly benefit mankind and at the same time create an appetite for the refinements of life and the material wherewith to satisfy this craving. A glance at workshop and general living conditions will convince the most skeptical that what mechanization and mass production has accomplished in the past half century, is nothing to what it will accomplish in the future. It is a practical certainty that in the formative period ahead many theories of present economists will have to go by the board. The long working day is one of them.

—ROBERT S. ALEXANDER,
Universal Winding Company



Long Service *and the* Pay Envelope

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An analysis of the relation between wages and length of service in standard machine tool occupations

■

FROM the standpoint of management, the significance of extended service on the part of employees arises largely through its relation to production. From the standpoint of the workers, its importance is largely in terms of wages. But from either viewpoint, there is difference of opinion as to the advantages of extended service. Some employers believe that, except for a short initial period, the advantages of long service are much overrated. Others believe that the major advantage of such service accrues to the employer in the form of lower unit costs rather than to the employee in the form of higher wages. Still others contend that the effectiveness of employees enhances over a considerable period of time and that both employer and employee gain by extended contact. In part, these diverse views reflect different industrial conditions, but in part, they reflect the absence of factual information.

To obtain definite information as to length of service and its relation to wages, an experimental survey of a few occupations was made late in 1927. This survey covered a few firms very intensively for the years 1925 and 1926. Eleven firms in the former and two additional ones in the latter year supplied information as to the service records of every male employee in selected occupations, who had been in their employ during the two years, also records of actual earnings and hours actually worked week by week for each employee in each year. This made possible a comparison of average hourly, weekly, and yearly earnings with length of service for about 500 men in 1925 and about 1,000 in 1926.

Up to a certain point, wage levels increase with length of service

Despite the consistency of the conclusions, even with a wide difference in the number of men involved, a subsequent survey was made. Partly to obtain more recent data and partly to cover a larger number of firms for a shorter period of time. This was done in October, 1929, when 48 metal manufacturing firms with 1,870 men in the selected occupations reported information for a period of one week. This information was comparable to that supplied by the smaller number of firms on a yearly basis.

The occupations selected are based on the operation of standard machine tools and are highly important in modern industry. In the most recent survey, the following were covered: boring mill, drill press, engine lathe, milling machine, planer, screw machine, and turret lathe operating. In the earlier survey, two of these, boring mill and planer operating, were omitted, and two others, screw machine and turret lathe operating, were combined.

In 1929, about 57 per cent of all the machine tool operators had service records of less than five years, while in both 1925 and 1926 there were about 70 per cent. Whether or not this change of 13 points can be considered as an increase in the duration of service is uncertain in view of differences in the number of firms and in the length of the periods. However, it is interesting to notice that, if the percentage data are comparable, then the shift in the direction of longer service has come through a decline in the proportion of men with service records of less than one year. In 1929 there were only 24.1 per cent of the men with such records as against 36.6 per cent in 1926 and 39.8 per cent in 1925. This decline of between 12 and 15 points approximates the increase occurring in the groups with service records of five years or more, where the proportions rose from about 30 per cent in both 1925 and 1926 to about 43 per cent in 1929. In all three years, the proportionate size of the group with moderately long service, or with records of one to five years, remained about the same, varying only between 30.4 per cent and 33.4 per cent.

But whether or not there were any changes in the

Table I—Number and Percentage of Total Number of Men by Length of Service in Specified Occupations, 1925, 1926 and 1929

Machines Operated	Number: Under 1 Year	1 Year and Under 5 Years	5 Years and Under 10 Years	10 Years and Over	Unknown	Total	Percentage: Under 1 Year	1 Year and Under 5 Years	5 Years and Under 10 Years	10 Years and Over	Unknown	Total
					1929*							
Boring Mill	28	57	58	62	..	205	13.7	27.8	28.3	30.2	....	100.0
Drill Press	93	125	62	37	..	317	29.3	39.4	19.6	11.7	....	100.0
Engine Lathe	101	130	111	122	..	464	21.8	28.0	23.9	26.3	....	100.0
Milling Mach.	61	93	73	28	..	255	23.9	36.5	28.6	11.0	....	100.0
Planer	20	12	20	27	..	79	25.3	15.2	25.3	34.2	....	100.0
Screw Mach.	65	85	41	33	..	224	29.0	38.0	18.3	14.7	....	100.0
Turret Lathe	41	51	34	24	..	150	27.3	34.0	22.7	16.0	....	100.0
Combined	409	553	399	333	..	1694	24.1	32.6	23.6	19.7	....	100.0
					1926**							
Drill Press†	84	57	35	16	..	192	43.8	29.7	18.2	8.3	....	100.0
Engine Lathe	74	83	55	57	2	271	27.3	30.6	20.3	21.0	.7	100.0
Milling Mach.	77	77	32	20	..	206	37.4	37.4	15.5	9.7	....	100.0
Screw Mach., Turret Lathe	112	99	38	26	3	278	40.3	35.6	13.7	9.4	1.0	100.0
Combined	347	316	160	119	5	947	36.6	33.4	16.9	12.6	.5	100.0
					1925***							
Drill Press†	24	18	14	14	..	70	34.3	25.7	20.0	20.0	....	100.0
Engine Lathe	76	61	25	46	..	208	36.6	29.3	12.0	22.1	....	100.0
Milling Mach.	24	20	10	17	..	71	33.8	28.2	14.1	23.9	....	100.0
Screw Mach., Turret Lathe	88	63	14	18	1	184	47.9	34.2	7.6	9.8	.5	100.0
Combined	212	162	63	95	1	533	39.8	30.4	11.8	17.8	.2	100.0

* Covers 48 firms; ** 13 firms; *** 11 firms.

† Sensitive and Radial Drill Press Operating Excluded.

duration of service, it is sufficient for the purpose at hand to notice that the largest group in 1929 is the one with moderately long service. About one-third of all the men are in this group with records of from one to five years, while both the under-one-year and the five-to-ten-year groups come next, with about one-fourth of the men in each. The remaining one-fifth is in the very-long-service group, or those with records of ten years or more. Thus an appreciable proportion of men is in each service group.

And the proportion of all the machine tool operators in each service group reflects fairly well the situation with the individual occupations. From Table 1, it appears that with 24.1 per cent of all the men having short service records (less than one year), the proportions for individual occupations vary from 21.8 per cent to 29.3 per cent, boring mill operation excepted. With the moderately long service group (one to five years), the aggregate proportion is 32.6 per cent, that of the individual occupations varying from 28.0 per cent to 39.4 per cent, planer operation excepted. For the long service group (five to ten years), the aggregate proportion is 23.6 per cent with variations from 18.3 per cent to 28.6 per cent for individual occupations. The greatest variation between occupations occurs with the maximum service group (ten years or more), where with an aggregate of 19.7 per cent, the individual occupations vary from 11.0 to 30.2 per cent. However, the largest proportions in this group occur with boring mill, engine lathe, and planer operating, and these occupations are generally considered as requiring much experience and skill on the part of the operator.

Between firms, the situation varies considerably, as might be expected, although at least a majority of the firms have some men in each service group. The absence of short-service men seems to be confined to the smaller firms. Only two firms had no men with less than ten years of service and only three others had none with less than five years, although there are twelve additional firms with no men of less than one year of service. These seventeen firms with no short-service men constitute about 33 per cent of all the firms, but represent about only 7 per cent of the men, with not over 27 men in any firm. For the firms with some short-service men, the proportions vary from 3.6 per cent to 75.0 per cent although the range for most of the firms is between 15 per cent and 45 per cent. And with the other service groups, the proportions for most of the firms is much the same, running from about 10 per cent to 45 per cent. It is interesting to notice that while the aggregate per-

Table II—Length of Service by Firms for Operators of Seven Standard Machine Tools, 1929 (Firms arranged in order of size)

Number of Men: Under 1 Year	1 Year and under 5	5 Years and under 10	10 Years and Over	Total	Percentage of Total Number of Men: Under 1 Year	1 Year and Under 5	5 Years and Under 10	10 Years and Over
71	63	107	50	291	24.4	21.7	36.8	17.1
40	69	23	27	159	25.2	43.4	14.5	16.9
42	86	28	1	157	26.8	54.8	17.8	.6
33	42	23	52	150	22.0	28.0	15.3	34.7
29	33	22	3	87	33.3	37.9	25.3	3.5
27	38	12	..	77	35.1	49.4	15.5	....
8	23	7	29	67	11.9	34.3	10.5	43.3
20	28	11	6	65	30.8	43.1	16.9	9.2
15	24	14	9	62	24.2	38.7	22.6	14.5
23	4	4	19	50	46.0	8.0	8.0	38.0
8	8	20	9	45	17.8	17.8	44.4	20.0
10	7	8	9	34	29.4	20.6	23.5	26.5
2	6	9	15	32	61.3	18.8	28.1	46.8
11	20	..	..	31	35.5	64.5	....	....
1	..	10	17	28	3.6	....	35.7	60.7
12	4	8	4	28	42.9	14.3	28.5	14.3
..	6	17	4	27	....	22.2	63.0	14.8
2	7	10	4	23	8.7	30.4	43.5	17.4
7	2	3	8	20	35.0	10.0	15.0	40.0
7	6	4	3	20	35.0	30.0	20.0	15.0
6	6	4	2	18	33.3	33.3	22.3	11.1
3	8	4	2	17	17.6	47.1	23.5	11.8
3	10	2	1	16	18.8	62.5	12.5	6.2
..	3	7	6	16	....	18.7	43.8	37.5
..	2	12	..	14	....	14.3	85.7	....
7	5	2	..	14	50.0	35.7	14.3	....
..	..	4	10	14	....	....	28.6	71.4
3	2	4	4	13	23.0	15.4	30.8	30.8
..	..	..	12	12	....	....	....	100.0
1	1	1	8	11	9.1	9.1	9.1	72.7
..	6	3	1	10	....	60.0	30.0	10.0
4	1	4	1	10	40.0	10.0	40.0	10.0
1	4	1	2	8	12.5	50.0	12.5	25.0
..	1	1	6	8	....	12.5	12.5	75.0
6	1	..	1	8	75.0	12.5	....	12.5
..	8	..	..	8	....	100.0	....	....
3	3	1	..	7	42.9	42.9	14.2	....
..	3	1	2	6	....	52.0	16.7	33.3
3	2	..	..	5	60.0	40.0	....	....
1	..	2	1	4	25.0	....	50.0	25.0
..	2	..	2	4	....	25.0	....	25.0
..	..	3	1	4	....	....	75.0	25.0
..	4	..	..	4	....	100.0	....	....
..	1	2	1	4	....	25.0	25.0	25.0
..	2	..	..	2	....	100.0	....	....
..	2	..	..	2	....	100.0	....	....
..	..	1	..	1	....	....	100.0	....
..	..	..	1	1	....	....	....	100.0
409	553	399	333	1694	24.1	32.6	23.6	19.7

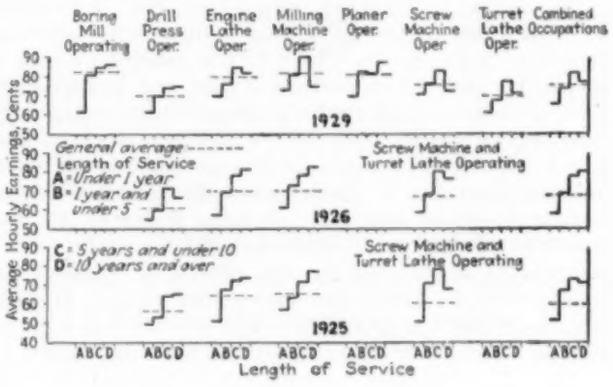
centage of short-service men exceeds slightly the percentage with very long service records, this latter group is distributed among 37 firms as against only 31 for the former group. See Table 2.

With the men in these occupations fairly well distributed among the different service groups, it is pertinent to inquire how the duration of service is related to wages. Table 3 gives the hourly and actual weekly average earnings by individual and by occupation in all three years. In view of the similarity in tendency with both hourly and weekly earnings, emphasis will be placed on the hourly figures as shown by the accompanying chart.

In 1929, the average hourly earnings, and actual weekly earnings, for machine tool operators as a group tend to increase with the length of service up to a period of ten years or more after which a decline in earnings occurs. The average hourly earnings for the several service groups, in ascending order, are 66.8, 75.6, 83.9 and 80.1 cents, while the average weekly earnings are, respectively, $34.34, $40.28, $44.56, and $43.33. This same tendency is found in 1925 and also in 1926 except that in 1926 the highest average occurs in the longest service group.

With the individual occupations, as well as with the combined occupations, there is a pronounced tendency for earnings to vary directly with the duration of service, at least up to ten years. In all three years and in all occupations, except planer operating in 1925, the average hourly earnings for the short-service group is lower and the average for the long-service group is higher than the average for the moderately-long-service group. But the average of the maximum-service group holds no consistent relation to the average of the immediately preceding, or long-service group, although it is always above the average of the short-service group and usually above the average of the moderately-long-service group.

Not only do average earnings vary directly with the length of service up to ten years or more, but the differences between the averages of successive groups, exclusive of the very-long-service one, are appreciable. In 1929, the average hourly earnings for the moderately-long-service group is 8.8 cents above the average for the short-service group and 8.3 cents below the average for the long-service group. The corresponding differences for actual weekly earnings are $5.94 and $4.28. And while it does not appear that average earnings continue to increase with service of ten years or more, still the average for this group is only 3.8 cents lower on an hourly and $1.23 lower on a weekly basis than the average for the highest paid, or five-to-ten-year-service group. In the other years, there are also marked differences between the average earnings of the groups, as is also the case with the individual occupations in all three periods. In 1929 for example, the differences between



the averages of successive groups, exclusive of the very-long-service group, are at least 5 cents and frequently 10 cents or more with the individual occupations on an hourly basis.

Even though both hourly and actual weekly earnings show a marked tendency to vary directly with the duration of service, it may be noted that the largest proportion of men are not in the service group with the highest average earnings. This is the case in all three years with both the combined and individual occupations. The highest average earnings generally occur with the five-to-ten-year-service group, while the largest proportion of men is in the one-to-five-year-service group in 1929 and in the under-one-year group in both 1925 and 1926.

It may be thought that the short-service workers are primarily boys or very young men and should, therefore, not be considered in relation to mature men who are likely to be in the other service groups. But such is not the case as shown by the 1925 and 1926 data. The average age for all the 531 men in 1925 was 34.2 years, as compared with 33.2 years for the 941 men in 1926. And these averages vary by only a year either way for individual occupations. It appears therefore that the men in these occupations tend to be ma-

Table III—Average Hourly and Actual Weekly Earnings by Length of Service in Specified Occupations, 1925, 1926 and 1929

Machines Operated	Average Hourly Earnings					Average Actual Weekly Earnings				
	Under 1 Year	1 Year and Under 5	5 Years and Under 10	10 Years and Over	Total	Under 1 Year	1 Year and Under 5	5 Years and Under 10	10 Years and Over	Total
1929*										
Boring Mill	66.7c	80.1c	84.4c	86.0c	81.5c	$37.12	$44.72	$46.00	$48.41	$44.79
Drill Press	62.0	70.3	74.1	74.7	69.8	30.36	36.24	37.53	40.88	35.62
Engine Lathe	68.5	75.0	83.7	80.9	77.5	34.85	39.47	43.78	43.72	40.57
Milling Mach.	74.8	82.4	92.1	76.5	83.3	38.09	44.92	50.56	41.31	44.72
Planer	71.1	84.0	83.0	88.9	81.9	38.77	49.04	44.58	52.10	45.49
Screw Mach.	72.2	77.1	79.1	73.6	76.3	35.75	40.97	47.32	35.53	38.83
Turret Lathe	61.2	67.9	78.4	72.0	69.8	30.29	35.61	41.29	35.23	34.70
Combined	66.8	75.6	83.9	80.1	76.8	34.34	40.28	44.56	43.33	40.25
1926**										
Drill Press	55.2	60.5	72.1	68.6	60.7	23.74	27.73	32.19	32.35	27.18
Engine Lathe	57.9	71.2	78.5	82.2	71.0	25.87	34.08	36.56	38.57	33.10
Milling Mach.	62.0	74.2	78.9	83.0	71.0	26.77	35.80	39.07	37.48	33.25
Screw Mach. and Turret Lathe	58.6	68.8	80.7	78.4	67.1	25.12	32.82	37.90	36.85	30.76
Combined	58.4	69.3	77.9	79.5	67.8	25.31	32.96	36.43	37.17	31.26
1925***										
Drill Press	49.7	53.4	66.3	64.5	56.7	21.84	25.76	30.51	31.32	26.48
Engine Lathe	51.8	68.9	73.9	74.7	64.1	23.03	33.69	35.82	35.67	31.53
Milling Mach.	57.9	65.4	74.3	79.7	66.9	26.84	31.18	36.18	35.85	30.49
Screw Mach. and Turret Lathe	51.4	73.0	82.2	70.3	63.1	23.61	36.40	38.51	34.16	30.25
Combined	52.0	68.8	74.5	72.8	63.2	23.57	33.55	35.29	34.78	30.02

* 48 firms covered; ** 13 firms; *** 11 firms.
† Sensitive and Radial Drill Press Operating Excluded.

The author desires to acknowledge the co-operation of the Metal Manufacturers Association of Philadelphia, and particularly the Secretary of that association, Earl Sparks.

ture individuals. When length of service is taken into account, the average age for all short-service men is 30.4 and 30.2 years in 1925 and 1926 respectively, as against 31.1 and 30.4 years for the moderately-long-service group. There is, however, a distinct break between the average age of the men with records of less than five years and those with five years or more. The average ages for these groups are respectively 30 and 43 years in 1925, and 30 and 40 years in 1926. Thus age does not appear to be a contributing factor of general importance to the earnings of short- and moderately-long-service groups.

A question is frequently raised as to how satisfactory a general average wage is for comparisons involving length of service. In Chart 1, the general average is shown by the broken horizontal line, and it appears to have a closer relation to the average for the moderately-long-service group than to the average of any other group. However, the general average bears no consistent relation even to the average for this moderately-long-service group in any year; in some instances, the two averages are about the same, but in others, the general average is above, and in still others, it is below the average for the one-to-five-year-service group. It seems therefore that the general average is much too high for comparisons involving short-service men, and much too low for those involving long-service men, while for the group to which it is most closely related it bears no consistent relation.

If the percentage data of 1929 are comparable with that of 1925 and 1926, then there is indication of a drift in the direction of longer service in these machine-tool occupations, even though the proportion of men with service records of one to five years remains about the same in all three periods. Average earnings, both hourly and weekly, tend to vary directly with the duration of service up to ten years or more. But in none of the three years is the largest proportion of men in the highest paid service group. When wage comparisons involving length of service are made on the basis of a general average, such a figure corresponds most closely to the average for the moderately-long-service group, but is not particularly reliable for this group. And even if the general average corresponded more closely with the average for the one-to-five-year group, there is only about 25 per cent of the men in this group. For comparisons involving the other service groups the general average is unreliable, being consistently too high for the short-service and consistently too low for the long- and very-long-service groups. There is reason to believe that in wage comparisons more attention might well be given to length of service than is usually the case.

NEW BOOKS

SOVIET FOREIGN TRADE, MENACE OR PROMISE—*By J. M. Budish and Samuel S. Shipman. 276 pages, 5x7¼ in. Bound in cloth boards. Published by Horace Liveright, Inc., 61 West 48th St., New York. Price $2.50.*

As stated in the preface, the purpose of this book is to give a rounded picture of Soviet Russian foreign trade. It is put out by the Economic Division of Amtorg Trading Corporation and therefore contains much statistical material of Russian origin.

Most of the text is devoted to statistics of international trade, and their interpretation. If one enjoys statistics he should be happy with this little volume, although there is some repetition in places. The growth of trade in some commodities since the establishment of the new Russian government has been remarkable.

The last three chapters are concerned with dumping, labor, and the Five-Year Plan. It is difficult to reconcile some of the statements with recently published correspondence in the daily press.

SCIENCE AND THE SCIENTIFIC MIND—*By Leo E. Saidla and Warren E. Gibbs, respectively assistant professors of English, Polytechnic Institute of Brooklyn, and instructor in English, Columbia University. First edition. Five hundred and six 5x8-in. pages, three appendices and index. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York, N. Y. Price, $3.00.*

Truer perspective of science as a means for the discovery of nature and its relations to modern culture is the end sought by the editors of this book. It has been prepared as a textbook, containing as it does questions and suggested readings in scientific literature, but strives to make clear the mental attitude of scientists and their processes of thought. Thus, twenty-four essays of non-technical, scientific character have been selected from the writings of eminent living scientists and those of the recent past. Each essay deals with the scientific method in its manifold relations to modern culture, that is, to art, poetry, religion, education, invention, and the individual. Such men as Millikan, Pupin, Tyndall, and Huxley are represented. When the vision, learning, and the truths expressed by such men as these are realized, it may well be said that no man is educated who does not have, in addition to a knowledge of the humanities, an insight into science and a knowledge of the work of these thinkers who are fully as great as the great minds so well known in other fields.

MODERN DIESEL ENGINE PRACTICE—*By Orville Adams. 656 pages 6x9¼ in. Cloth-bound covers. Indexed and illustrated. Published by the Norman H. Hanley Publishing Company, 2 W. 45th St., New York, N. Y. Price $6.00.*

Practical men interested in the installation, operation, maintenance, and repair of Diesel engines will find much useful information in this book. It deals not only with stationary applications of Diesel engines, but with portable types and with the forms used in railway and automotive vehicles, including aircraft.

There are also chapters on the engineering of Diesel plants, including the supplementary equipment required, underwriters' regulations, and related items. No effort is made to deal with design from the theoretical standpoint as the book is not intended for engineers concerned with design. The book is well illustrated.

Production Milling of Cams

C. R. RANNEY
Jones & Lamson Machine Company

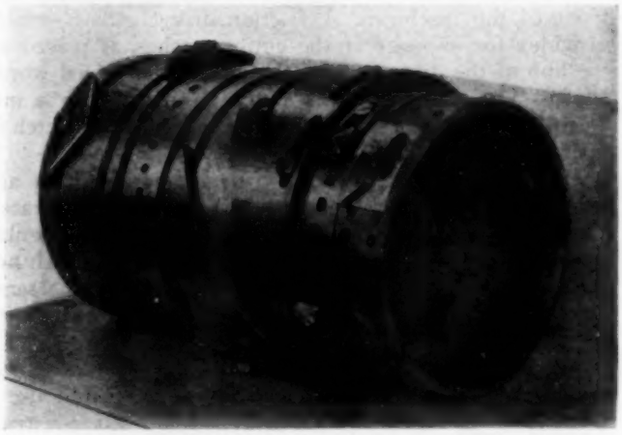


Fig. 1—A filed contour no longer suffices for cams such as these

It is one thing to make a cam and another to make a quantity on a production basis. In one shop, a special milling machine supplied the answer

WHEN cylindrical cams were cast to shape and the working surfaces finished with a file, the problem of manufacture was comparatively simple. As service requirements became more exacting, cast steel was substituted for cast iron. But present standards of accuracy do not tolerate molding variations in these members. So it became necessary to finish them by milling or grinding.

Cylindrical cams are widely used on automatic machine tools. Each Fay Automatic Lathe manufactured by the Jones & Lamson Company requires several similar to that shown in Fig. 1. To produce these cams at a reasonable cost, a special cam milling machine was designed and built. A period of operation has proven it to be of value. Though designed as a special purpose machine, it may easily be adapted to a large variety of cams. Fig. 2 shows the front and left side elevation while Fig. 3 shows the rear.

The machine operates on a familiar principle. A standard milling cutter travels over the work guided by a follower roll which moves over a master cam or templet. The work and templet are carried on two drums which revolve under the cutter and follower respectively. A counterweight keeps the follower roll in contact with the master cam.

Referring to the front elevation in Fig. 2, *A* is the rigid cutter slide gibbed to horizontal ways. This member carries the vertical cutter spindle *B* and the housing for the follower roll spindle *C*.

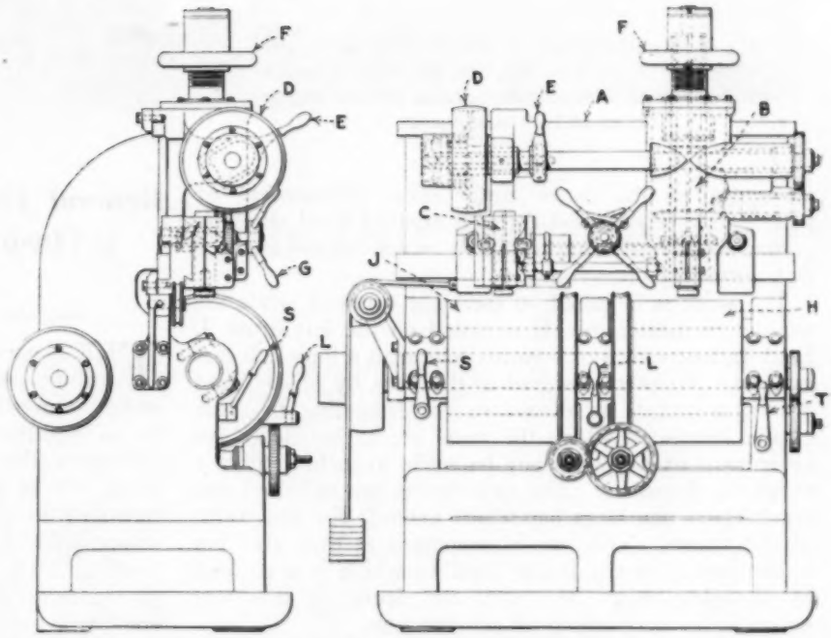


Fig. 2—The master cam is mounted on one drum, the work on the other; by changing the relative speeds of the drums variations in lead may be obtained

The drive for the cutter and feed are entirely independent. The cutter drive is delivered through a clutch pulley *D* on a drive shaft mounted on the cutter slide and geared through change gears to a bevel pinion shaft. The bevel pinion meshes with a large bevel gear keyed to the spindle. A clutch lever *E* is conveniently located for starting and stopping the cutter. Various cutter speeds may be obtained by use of different change gear combinations. Vertical adjustment of the cutter is provided for by hand wheel *F* at the upper end of the spindle. Horizontal

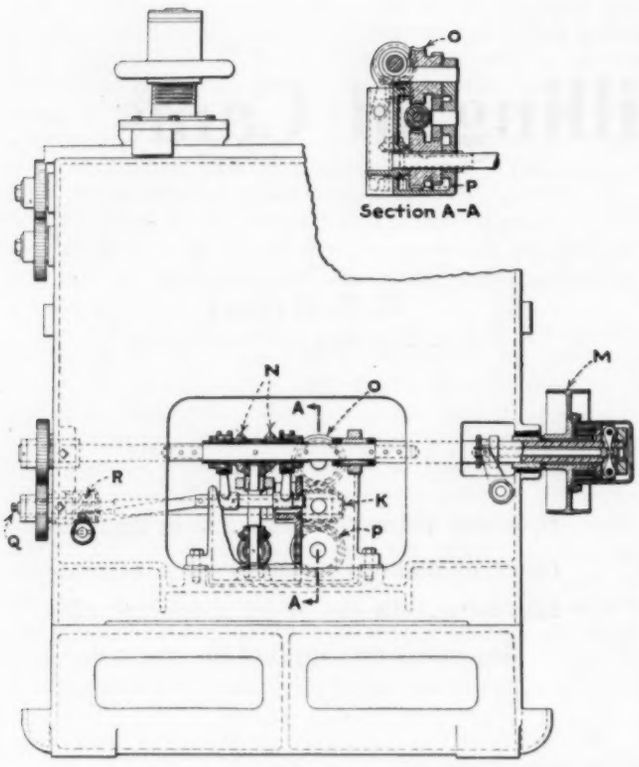


Fig. 3—Rapid traverse in either direction is controlled by two friction clutches; the traverse control is interlocked with a feed clutch to prevent engagement of both simultaneously

movement of the entire cutter slide, independent of power, may be obtained through another hand wheel *G* at the front, operating a pinion which meshes with a rack secured to the frame.

The work is mounted on the right drum *H* while the templet or master cam is mounted on the left drum *J*. Each drum consists of a worm gear with a long hub cast integral. Adapters, secured to the hubs by filister head screws are made to diameters corresponding to those of the drums on which the cams are to be used. An assortment of adapters may be made to include quite a range of diameters. The two drums are mounted and revolved on one large bar which extends the full width of the frame. This bar is supported at each end and in the center by the frame itself to which it is secured by clamping caps. Mounting the drums in this way makes an exceedingly rigid construction.

The drums were driven from the under side by worms on two parallel shafts. These two shafts are driven from the feed gear box shown at *K*, Fig. 3. The two worm shafts, which drive the drums, are geared directly to each other and therefore rotate in opposite directions. To turn the two drums in the same direction, the worm drive for one is right-hand and for the other left-hand. The pitch of the worms is the same.

The feed drive is delivered to the feed drive shaft through a pulley and clutch *M* at the side and rear of the frame. On this feed drive shaft are two bevel gears with cone friction clutches integral with their hubs. These are so arranged with sliding spools as to give forward and reverse fast motion to one of the drum drive shafts. Lever *I* controls this rapid traverse and is so interlocked with the feed clutch that feed and traverse cannot be thrown in simultaneously. When the fast motion clutch is in its neutral position, the feed drive is transmitted through change gears to the intermediate feed worm shaft. This shaft is carried in a swivel box so the worm may be brought into mesh with either one or the other of two worm gears *O* or *P*. By shifting the worm from one worm gear to the other, the direction of rotation of the drums is reversed. This reversal of feed is controlled by a lever *L* conveniently placed at the front of the machine. A friction disk clutch *R* which provides for slippage if the cutter catches, is placed in the hub of the drive gear of the intermediate feed worm shaft. The tension of this clutch is adjusted by a nut *Q* at the end of this shaft. The main feed drive clutch is operated by lever *S*.

It is evident that if the two drum worm shafts are geared to each other by gears not in one-to-one ratio, the two drums will not revolve at the same angular velocity. This makes it possible to cut cams which are not duplicates of the master. In other words, the same master cam may be used to cut a series of cams with varying leads depending upon the gear ratio used.

When the machine was originally designed, cast-iron cams were in use. When steel cams came into use a pump for cooling compound was added. The construction of this cam milling machine is extremely simple and rigid. Clutches, pulleys, and other small parts were used from the stock of regular Fay Automatic Machine parts. This expedient, with other features of the design, enabled building the machine at low cost.

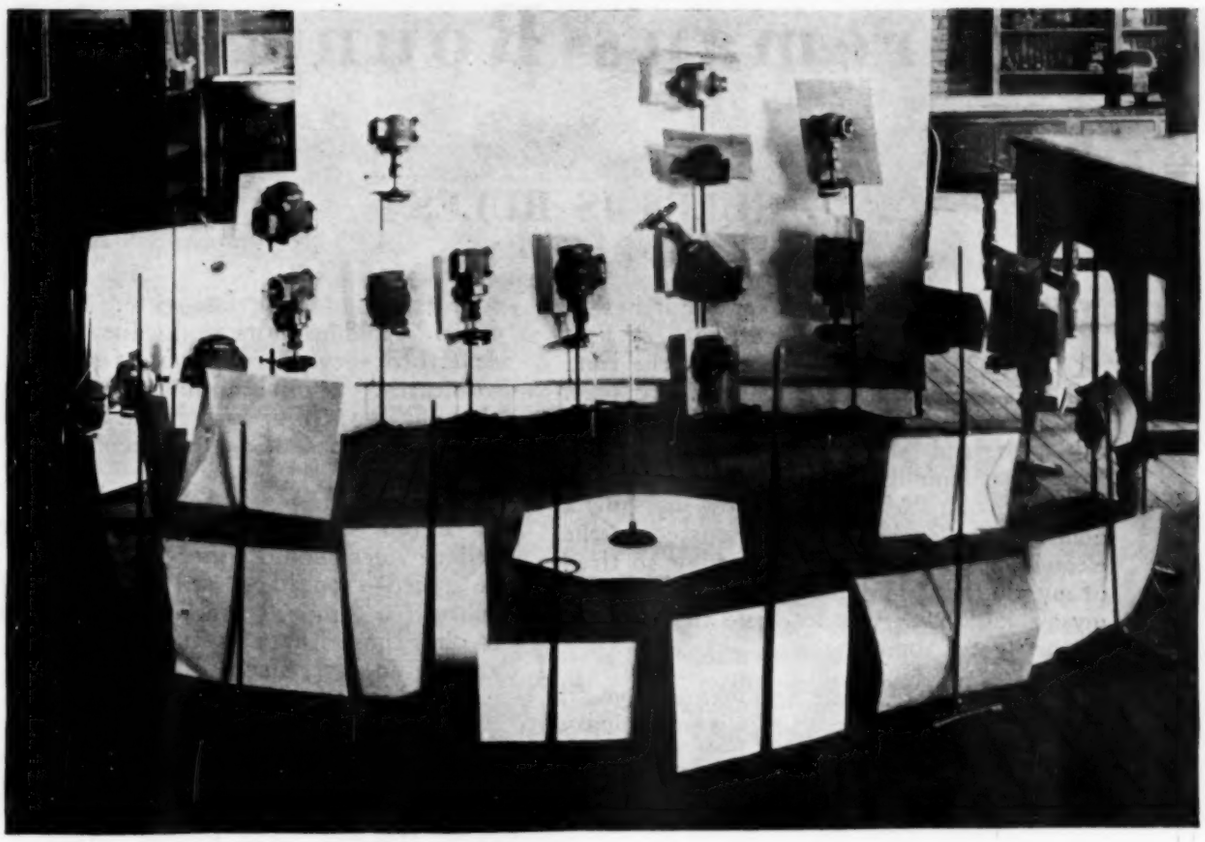
■

General Electric Has An Unemployment Insurance Plan—*Discussion*

W. R. NEEDHAM
Engineer, Design Dept., English Elec. Co., Ltd.

THE *American Machinist* editorial, page 66, Vol. 73, dealing with the General Electric Company's scheme makes interesting and provocative reading. There can be no question that one of the gravest questions the average worker has to face is that of possible unemployment. It is a matter which most of all affects the mentality of the man who takes a serious view of his responsibilities. Such men are often the backbone of the working force. The psychological effect of a reasonable assurance of security is greater than most men or most employers realize. On the man's part, he can devote himself to his tasks single-mindedly, with the attendant gain in interest and reliability. The employer secures better work and a lessened labor turnover.

Unemployment insurance is a good scheme in principle. Like everything else, the proof of that pudding will be "in the boilin' and the eatin' o't." It is, perhaps more than anything else, a matter for the strictest actuarial scrutiny. Times of general depression will test any scheme with ruthless severity. It is wise to put the scheme upon a co-operative rather than a philanthropic basis. The workers should, in their own best interests, do their bit. It will be all the better when all sections of all industries lend a hand in the good work. In the meantime, it is for the pioneers to lead the way. For anything like assured success it is probable that the response will need to be on a national scale.



Testing With the Gamma Ray

GAMMA rays are of growing importance among the methods being developed for non-destructive testing of welded sections. This method is somewhat similar to X-ray testing, but has proved peculiarly adaptable to heavy sections and is more readily portable than most other methods. It may also be used for detecting any type of flaw or blowhole in metallic bodies either cast or rolled, or in inspecting parts in machine assemblies.

Ordinarily, a particle of radium in a glass capsule is placed so that the gamma rays emanating from it will pass through the body being tested and impinge upon a sensitized film placed against the rear surface. After a period of exposure depending upon the thickness of the piece, the distance from the radium to the sensitized film, and the amount of radium used, the blowholes or other defects will appear on the developed film, just as in X-ray photography.

When testing tubular structures or tanks the radium is placed at the axis of the tank and the sensitized film wrapped around the outside. The accompanying illustration shows a number of small parts being tested simultaneously, the radium capsule being on the stand at the center. Thus, a great number of pieces may be tested at one time, as many, in fact, as can be placed on the surface of a sphere of the desired distance from the radium.

Dr. Gilbert E. Doan, in an A.S.T.M. paper at the recent Symposium on Welding in Pittsburgh, stated that, in investigating a piece of steel 10 in. thick, two grams of radium were placed 15 in. from the sensitized film. With this set-up, an exposure of 12 hours was required. The intensity of the rays emanating from the radium varies inversely as the square of the distance from the capsule. Thus, if the distance from the capsule to the film is doubled, the exposure necessary becomes four times as great.

Reasonable care must be used in handling radium. For transportation, the capsule is placed in a lead box having a wall thickness of about 1 in. The carrying box must be kept at least 3 ft. from the body, and the capsule must be handled with a pair of forceps. During exposure, the operator can leave the room. With ordinary, intelligent care, there is little danger from handling the material.

One major present difficulty is the high cost of radium —about $70,000 a gram. This is, however, lessened by the fact that it has a useful life of something like 1,600 years, during which the value of the investment is practically a constant. It is, of course, not necessary to have an entire gram of the material in order to test welds. Also, emanation from radium, which has a useful life of about four days, may be used for testing. Radium or emanation can, however, be rented for any desired period from certain sources.

The Foreman's Round Table

"RULES IS RULES"

IT WAS Monday morning. Further, it was Blue Monday. Ed has been fishing over the week end despite the rain, and was lame and sore, particularly sore. He came out of his home and climbed in beside his friend Al. He did not say a word for several minutes. Eventually he sighed and burst out, "My gosh, I know just how a man feels when he is being escorted to the electric chair. I'm actually getting so tired of my job that I'm going to have to blindfold myself and have you lead me through the factory gate, soon."

"Yeah? Here, have a smoke and you'll feel better. I suppose all this is preliminary to telling me that you had no luck, just to get out of giving me that mess of fish you promised."

"Yes, I promised the wife one, too. She says we'll have it for supper tonight, so I'm likely to find nothing to eat when I get home. But let's talk about something more cheerful, that last rule of Williams' for instance. I thought some of the other rules were bum, but this one is a joke. I read it to the boys in camp and you ought to hear them laugh."

"What struck them as so funny? That was a rule for observing rules and it removed some of the objections that you and your friend Joe Cook have to orders in general. What part struck you as being comical?"

"The whole thing. First, Williams issues a whole raft of orders that he calls accepted practice rules. Then, when we are getting used to them, he issues another telling the foremen to use their judgment about enforcing the other rules he issued. If that isn't inconsistency, what is?"

"Ed, you're a pretty good guesser, but you are no Einstein at reasoning. That is proven by the fact that your favorite and only pastime is fish. A man who fishes, guesses. He guesses what kind of bait to use, he throws it into the water without any thought or knowledge that there is a fish within a thousand miles. Then he waits, and waits, and so on. And then they arrest people for gambling with cards. There is nothing of exact science about fishing: either you get 'em or you don't. And your ideas of management are about the same."

"Is that so. I do believe in rules, and I believe rules should either be obeyed or not be issued—you have said that same thing yourself a hundred times. Me, I'm going to obey those I have to the letter. How can anyone do different?"

"Ed, an economic law is something that happens a majority of times, not invariably. A rule is likewise applicable in only a majority of cases. If applied invariably, it will cause trouble. The method of going on strike in Italy and England, is to obey all the rules all the time, and it is just as ruinous as an absentee strike would be."

"I don't agree with that, Al. It ain't square to pull a rule on one poor cuss and then let the next one get by, 'Pigs is Pigs,' and 'rules is rules'."

The notice that caused this discussion reads as follows: "Subject—Consistency in following orders:—(1) Consistency should never stand in the way of an obvious exception. (2) Obeying rules, and enforcing orders one hundred per cent, and in the face of adverse conditions, indicates a lack of judgment. Not following them at all denotes carelessness. (3) Seventy per cent of any job will take care of itself if left alone. Foremen and supervisors are expected to use judgment only where an exception to some rule or method occurs. (4) A supervisor is not subject to criticism in any case where he uses his judgment and is wrong, but he is at fault when he uses no judgment at all. The details of any rule or order require interpretation according to the existing circumstances. Its fundamentals are not violated thereby."

Does Williams' rule nullify those that have preceded it, or does it amplify them? Is such a provision good management? Will it work as Williams expects it to?

▸ ▸ ▸ Discussion of Former Topics

On Again, Off Again

Every man has a certain amount of individuality plus ambition to get ahead. The brighter he is the more he will be on the outlook for something which, in his own mind, will be an advancement. It follows that, if his foreman is alert, he recognizes this condition and makes an attempt to guide these characteristics, which are an asset to all concerned, and to provide an outlet for them.

There is an attitude sometimes that a man is just another man: if he is not satisfied, it's just too bad. Frequently a foreman can offer advancement to promising men by means of work classification, thereby providing an incentive for men, encouraging their ambition and developing their individuality. Many cases of dissatisfaction could be dealt with in this manner. The exceptions that secure outside connections and fail to make good, if taken back to their original job, appreciate the opportunity and make better workmen. Those that make good on a new job feel very kindly towards their former employers, knowing they could have returned if it had been necessary or desirable.

—JACK SARGENT, *Foreman, R. Wallace & Sons Manufacturing Company.*

Age and its Compensations

Any company that pays a fair rate for a job will have no trouble in disregarding seniority and age when applying wage scales to their dividend earners. Wage rates must be governed in great part by rates in other industries in town, as these determine to a large extent the standard of living. Competitors' wage rates must also be considered, as the fundamental idea of every business is to live.

There is one and only one way to recognize individual achievement, and that is by paying for it. Regardless of whether it is through promotion to a better paying job, a cash bonus, or a wage increase, it eventually resolves itself into cold money. A pat on the back, or a letter from the general manager and a notice on the shop bulletin board make a body feel good momentarily, but when the recognition is in hard cash, the feeling lasts and acts as a spur for further achievements.

—E. E. GAGNON, *Mechanical Superintendent, Raybestos-Manhattan, Inc.*

No Exceptions

A general order of this kind is usually issued by the manager or the board of directors. If provisions for exceptional cases are not included, then no exceptions should be made. Men in high positions do not like to be asked to reverse a decision. The loss of a few men is regrettable, but a general order soon loses its value if exceptions are made.

In the case of a man who has shown outstanding initiative, the problem is one for the man to solve and not the company. The company has decided to make proper recognition some time in the future. The man must decide to wait or go elsewhere. Going into a new job during hard times is not always wise, as immediate gains may be lost later on.

—L. F. SWENSON.

The End of the Road

I think the practice of firms promoting their own employees to fill better positions is a sound one that works to the best interests of both firm and employee.

It gives encouragement to the more ambitious men to qualify for better positions, and at the same time the firm has the advantage of keeping men of proved ability, who, they know, will fill the positions satisfactorily.

The transfer of a man from one department to another needs careful consideration. There is only a limited number of men with whom this can be done beneficially.

—J. W. HESKETH, *Coventry, England.*

Wide Open

A foreman's office is better enclosed. If it is enclosed in glass he can still see over the shop. Perhaps the general manager may have things to say to the foreman which he does not want other people to hear. If the foreman has a telephone, he probably would not be able to hear unless the telephone was in a booth which would necessitate the foreman's getting up from his desk to answer it.

Therefore, enclose the foreman's office. I believe he is entitled to some privacy.

—WALTER J. WRIGHT, *Fleming Iron & Steel Company.*

Tolerances

The situation described is not surprising, for it represents a condition which has grown up through laxity in many industries. "Experience" is confused with rigid supervision. Experience tells the shop man that certain tolerances are unattainable except at prohibitive cost: experience tells the inspector that practical tolerances have sufficed in assemblies made in the plant: but the one thing this experience fails to do is to tell the drafting room and planning office anything at all about the matter.

That many tolerances established by designers and draftsmen are too rigid is an admitted fact. That a drafting room or engineering department is unwilling to listen to "demonstrated reason" is not. Too often shop men kick in glowing generalities, insisting that they are right merely because they say so. If they will be honest and reduce their objections to tangible cases, giving cost facts and figures, as well as logical reasons why lesser tolerances will do, much of this sort of difficulty could be obviated.

—LEWIS J. YAPP, *Draughtsman, Naval Aircraft Factory.*

Fragment of a head of Queen Nefertiti, formed in yellow jasper, an extremely hard siliceous mineral. How were the lines about the lips and those on the neck formed?

"The Ancient Egyptians had Stone, not Steel"

E. J. TANGERMAN
Assistant Editor

In the last number of *American Machinist*, Henry D. Hibbard advanced the opinion that the Egyptians had tools of hardened steel. Herewith are presented the reasons why Egyptologists refute the theory

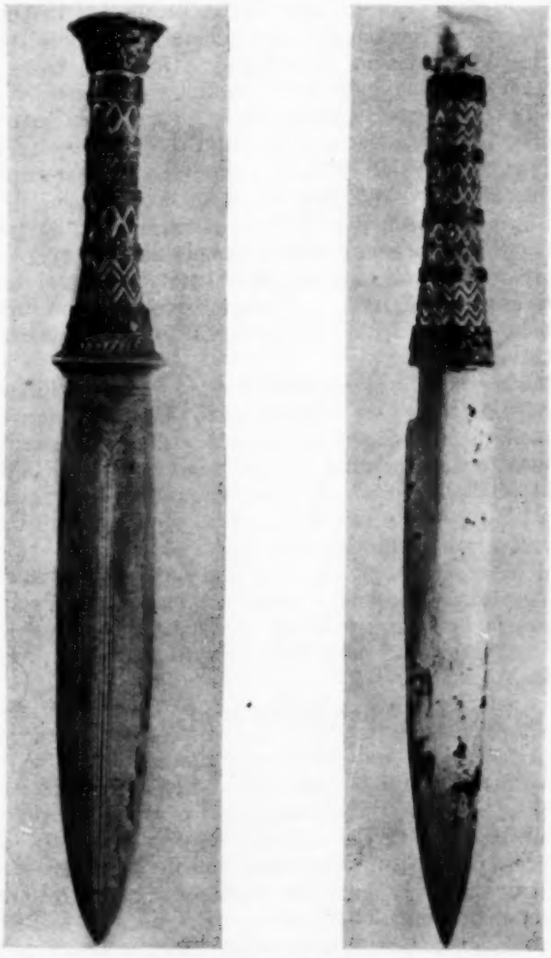
OURS is a lazy civilization. The ancient Egyptians, 5,000 years and more ago, could do practically everything with materials which we can do today; we have simply applied mechanical power to the operations. Modern engineers and architects marvel at the Pyramid of Cheops, frankly admitting their inability to duplicate it even with all our modern aids to materials handling, stone cutting, and engineering. Built by Khufu in the years following 2,800 B. C. as his own burial place, it is not only the most considerable of all architectural works in bulk, but one of the most perfect in execution. Although over seven hundred and fifty feet on a side, it was laid out with such accuracy that Petrie (famous Egyptologist) reports its divergencies from exactness in equality of sides, in squareness, and in level, no greater than his own probable error in measuring it with the most modern surveying instruments (Kimball and Edgell, "A History of Architecture"). And this is but one example of the engineering skill and the tremendous amount of stone working accomplished by the Egyptians!

We, as a people, magnify our accomplishments, deprecate earlier people's, and somewhat vaingloriously assume that because we have been unable to accomplish some certain thing, it cannot be accomplished. We assume automatically that the Egyptians, at best, could have had tools only partially as good as ours, yet we are unable to explain their works, even judging by our modern standards of what man can and cannot accomplish. But the Egyptians, too, had their foibles. Even with their phenomenal engineering ability, they were unable to build labyrinths, portcullises, and misleading passages which would keep despoilers from their sacred dead. Their elaborate safeguards were proved ineffectual only a few centuries after their construction, and by vandals who possessed far less intelligence than the builders. But so has it ever been with the intelligentsia, ancient or modern.

Our machines have brought us back to the point from which the Egyptian deteriorated—to the building of monumental works. We are even now engaged in an effort to perpetuate our civilization by carving battle scenes in relief and by incising 500-word histories in the faces of great natural monuments. The Egyptians did as well, but without machinery, as we know the term, to aid them. They quarried, then ferried, 2½-ton blocks of stone across a river and to a pre-selected site to build the Great Pyramid, and the blocks, when placed, fitted so well that the joints were scarcely visible. In fact, their selection of materials and their cutting of them was so well done that the builders of Cairo, many centuries later, who possessed iron tools, found it much easier to re-use the blocks than to quarry their own. The Egyptian stone worker worked chalcedony, calcite, Iceland spar, quartz, pearl, rock crystal, carnelian, garnet, jasper, beryl, feldspar, peridot, lapis lazuli, turquoise, agate, onyx, haematite, sardonyx, alabaster, basalt, breccia, diorite, dolorite, flint, granite, gypsum, limestone, marble, obsidian, porphyry, quartzite, sandstone, schist, serpentine, steatite—even emery! We find difficulty in cutting many of these materials today.

Photographs through the courtesy of the Metropolitan Museum of Art.

These evidences of ancient Egyptian stone cutting can point to but one possibility—that of a material harder than ordinary copper for cutting. We have been offered theories that hardened copper, even iron or steel tools, were used; why not advance the logical conjecture that a material harder than steel was available? Simply because *we* have been unable to find a material entirely satisfactory for this class of work is no indication that *they* might not have done so. That they had hard tools goes unquestioned. A recent example, related by Ambrose Lansing, Egyptologist at the Metropolitan Museum of Art, New York City, will suffice to prove this contention. In the Museum is exhibited a fragment of a head of Queen Nefertiti (XVIII Dynasty, 1375-1358 B.C.) formed in yellow jasper, an extremely hard siliceous mineral. The fragment is so finely cut about the mouth that it is impossible to conceive of such workmanship by abrasion or attrition alone. It is clearly a job of cutting with a tool. Yet when an effort was made recently to drill a ¼-in. hole in the base of the fragment to permit it to be mounted, all sorts of difficulties were encountered. Workmen found our hardest high-speed drills would not touch the material. Then they tried a tubular drill with emery, still without success. Finally, they borrowed a diamond drill, and succeeded in cutting a hole an inch or so deep after four or five hours' work. Jasper is not a material that grows harder with age, nor is it, from this evidence, a material that would take kindly to the ministrations of even the hardest of our steel chisels, granting even the difference in cutting power between a drill and a chisel impelled by blows. Yet the Egyptian formed a head—perhaps an entire statue—and gave it a mirror polish to boot! Even this is not all. Granting that polishing was probably done with a stone and powdered emery or powdered jasper, how else than with a tool harder than jasper could the fine lines about the lips have been incised? But the Egyptians formed statues and vases of materials harder than jasper, and did it regularly and in quantity even before copper probably was known to them!



The daggers found on Tut-Ankh-Amen's mummy, on the left a gold, on the right, an iron dagger with gold handle. The rust spots are plainly marked on the otherwise shiny surface

Herodotus, pioneer globe-trotter (450 B.C.), described the building of the Great Pyramid after a visit to Egypt. Inadvertently, in describing the cost of the pyramid, he says: ". . . how much more was probably expended in *iron* tools, in bread and clothes for the laborers . . ." (Herodotus II, 124). This statement has been seized upon by modern metallurgists as proof that the Egyptians had "iron"—which they consider to have meant "steel"—tools. Herodotus, none too accurate at best, was familiar with iron, so assumed, as modern metallurgists do, that the tools used some two and a half thousand years earlier had been of iron (Lucas, "Ancient Egyptian Materials"). But even nowadays, we use the term "stainless steel" to describe a hundred or more materials with widely differing characteristics.

Worthy of record, however, is the finding of an actual, authentic piece of iron in the Great Pyramid in 1837. It was, however, not a tool nor did it appear to have been part of a tool, and was in reality haematite or a meteoritic fragment, hence not steel in any sense of the word. In fact, it is rather generally conceded that methods of making steel were not discovered until somewhere around 700 A.D., when a method of attaining and controlling the required heat became available. But Mr. Hibbard assumes that bronze tools "did well enough for purposes of war," forgetting that Egyptian kings spent a great part of their time at war. Then, as now, weapons were of the toughest and hardest materials available.

We know definitely that the Egyptian had the bow-drill, tubular drill, and saws and chisels of wood with stone inserts. The stone-pointed drill with shaft, fly-wheel, and crank for turning was invented before 3,000 B.C. (Gardner, "Art Through the Ages"). Again, the art of hollow casting was invented before 1,000 B.C. (Chase, "A History of Sculpture"). The prehistoric craftsman knew the art of soldering, for the metal workers soldered gold so skillfully "that it can scarcely be detected with a magnifying glass" (Gardner). And in these soldered gold ornaments, he placed bits of red jasper, amethyst, turquoise, and other semi-precious stones, obviously partly cut and partly worn to the desired shape. The breaking down of larger stones was comparatively easy by the wetted wedge method which Mr. Hibbard explains. Finishing was a process of wearing down, with fragments of stone and probably some abrasive such as emery. A few objects of emery dating from Predynastic and early Dynastic times (3,000 B.C.) have been found in Egypt, including a plummet (Petrie), a double vase (Quilbell), two small blocks thought to have been used for polishing beads because of their grooved condition (Petrie), and a lump of the material (Lucas). The carving of emery into these various objects is almost a denial of its use as an abrasive. What

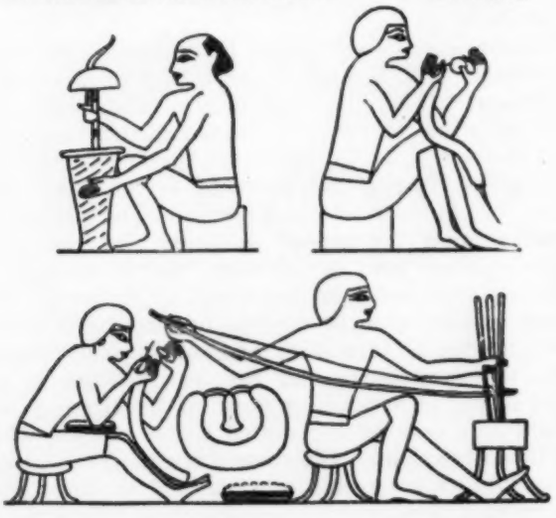
then, was the material which cut the hardest minerals and acted as an abrasive on emery?

Metallurgists say it was hardened steel, Egyptologists say it was flint or quartz, but why not assume it was diamond, sapphire, or an ancient variant of Stellite or tungsten carbide, shaped and fitted or soldered to a handle? Authorities claim that diamonds, rubies, and sapphires were not known (Lucas). But Lucas himself admits that few subjects in Egyptology are so full of confusion, and even of contradiction, as the nomenclature of various kinds of "stone" employed by the ancient Egyptians. It is known that they imported, before 3,000 B.C., such materials as emery, gold, lapis lazuli, ivory, jade, obsidian, resins, and at least one kind of wood. Many of these materials came from diamond-bearing regions, and considering the lack of knowledge of the exact identity of the cutting stones used, is it not logical to assume that among the imports were diamonds and sapphires? They were among the earliest stones known to man and were recognized as extremely hard. Considering the ceaseless search for materials by the Egyptians and the well-developed state of their export trade, this premise is certainly much less ridiculous than the premise that tool steel was available.

The Birth of Bronze

Mr. Hibbard admits that thousands of years probably elapsed between the discovery of bronze and that of iron, while advancing the opinion that steel tools were available. Yet it appears that even bronze was not discovered until about 3,000 B.C. It must not be forgotten that the Egyptians did not discover bronze. Tin was not native to Egypt; the first examples of bronze must, therefore, have been imported. But even if it was available, was it hardened other than the small amount possible by hammering? There is a possibility, in fact a probability, that some of the bronze was in realiity what we know as silicon bronze, in which we have attained tensile strengths as high as 130,000 lb. per sq.in. Any bronze founder will explain how difficult it is to get a bronze containing no silicon. But whether bronze, silicon-bronze, or steel tools eventually became available, it must be admitted that before even copper tools were known, therefore without their help, flint was worked and other small objects were fashioned out of quartz and other hard materials. Bowls, vases, maceheads, and other objects were made out of hard stone, and some of the most perfect statues that have survived from ancient Egypt were executed in such hard materials as diorite-gneiss and fine-grained schist, while statues, sarcophagi, and other objects were made of granite, also employed to a limited extent for building purposes. The advent of bronze brought no new triumphs in stone working; it merely extended its use and made the task easier. The same statement is true of the advent of steel.

A STONE VASE IS HOLLOWED OUT BY THE USE OF A HAND-DRILL WITH A REVOLVING HANDLE AT THE TOP. BELOW, A MULTIPLE BOW-DRILL WITH THREE CUTTING POINTS, IS USED IN MAKING BEADS WHICH TWO MEN ARE STRINGING.



FROM WALL-PAINTINGS IN THE TOMB OF REKHMARA, THEBES. DYNASTY XVIII (1535-1450 B.C.)

STONE WORKING

Ancient Egyptian stone workers. At the lower right is the ancestor of the multiple-spindle drill. These drills were "stone tipped"

Egyptologists offer the negative evidence that no tools of steel have been found in prehistoric excavations. Metallurgists explain this deficiency in one or more of four ways; that it rusted away; that it was ceremonial or menial, therefore not buried with kings; that it was taken by vandals or later peoples; or simply that it was far too rare and valuable to bury—even with kings. That the first reasoning is fallacious is proved by the discovery, by Howard Carter in the Tomb of Tut-Ankh-Amen, of an iron dagger with a gold handle and gold sheath. When found, it had only a few rust spots on its otherwise shiny surface! And metallurgists admit that the temperatures required to produce non-rusting wrought iron were not available to the Egyptians. Further, the combination of two metals in the dagger implies a rather advanced knowledge of metal working.

If it is assumed, for the sake of argument, that the metal *did* all rust away, then where is the iron rust? It is certainly not vagrant and would not disappear, when even the dust of food and fragments of cloth remain. Further, the climate of Egypt is dry and not conducive to rusting.

That the metal was ceremonial or menial, therefore not buried with kings, is disproved by even the slightest knowledge of the Egyptian religion. They believed that the soul, or Ka, required *everything* in the after life that it did in this, and as deeply religious people, provided everything possible for the comfort of the souls of the Pharaohs, who were to them gods. Further, were the metal ceremonial or menial, Tut-Ankh-Amen would most certainly not have carried an iron dagger on his person, had an iron rest under his head, and an iron ring! That would have been tempting the evil spirits too far.

Where is the Iron?

That the metal was taken by vandals is plausible, but in the unrobbed tombs that have lately been discovered, where is the iron? Further, it is far more plausible to believe that the vandals robbed the tombs for the diamonds, sapphires, of other hard cutting minerals, which torn from their mounts, are much more easily lost than are pieces of iron. The Romans, after the Fall of Rome, removed the iron cramps from between the stones of the structures built by their predecessors because they were unable to smelt it themselves. If a similar thing occurred in Egypt, why are not the pieces from which the iron was torn still in evidence? Mounts for stones have been

found, copper tools have been found, but of iron but a trace.

That the metal was too rare to bury with kings is disproved also by the religion of the Egyptian. He gave everything for the comfort of the soul, far more so than even our most devout present-day remembrancers of the dead. That the metal, as late as 1,350 B.C., was extremely valuable is borne out by the finding of the pieces of iron *on* the mummy of Tut-Ankh-Amen, as described by Howard Carter. Mr. Carter thinks the metal was only being introduced into Egypt at that time. Lucas places the beginning of its regular use as "about 800 B.C.," describing earlier pieces as possibly made from meteorites or haematite or received from abroad as gifts or curiosities. Other Egyptologists place the introduction of iron at anywhere from 1,500 B.C. to 1,000 B.C. It is known, however, that Rameses II, who followed Tut-Ankh-Amen, had a sword of iron and ordered a shipment of the material from one of the Hittite kings, indicating that Egypt, as late as 1,300 B.C., imported iron for her needs. Could the Egyptians then, have had it for stone cutting two thousand years earlier? A list of the discoveries of iron may point out a solution.

First Known Iron, 3,400 B.C.

Haematite was employed before 3,400 B.C. for shaping into beads, amulets, and other small objects, but there is no evidence that the abundant good-quality Egyptian ores of iron were worked before Roman times. The earliest pieces, when found, were entirely in the condition of the oxide (Lucas). The piece in the Great Pyramid is next in age, and after that several pieces of pickaxe of the Fifth Dynasty (2,750 B.C.) found at Abusir. Additional items, in order of their age, so far found include: a mass of iron rust from Abydos (Sixth Dynasty) an iron spearhead (Twelfth Dynasty), parts of a chisel and a hoe (Seventeenth Dynasty), then the pieces found with Tut-Ankh-Amen. The first tool, however, it will be noticed, was of the Fifth Dynasty, more than a thousand years after many of the great works in hard stone had been completed. Further, they were soft iron of the spongiest sort, hence of little practical value.

One factor not ordinarily considered by metallurgists propounding the steel theory is the fact that in manpower and patience the Egyptian had tremendous resources. The Great Pyramid is said to have taken 100,000 men twenty years to build! Written evidence has been found proving that it was common procedure to provide labor simply by capturing and enslaving a hostile town. Joppa was taken in 1,475 B.C. in this way, the Prince of Joppa being bound with *copper chains*.

The conclusion is inevitable. Tools of flint and other hard minerals are known to have been used; adzes, saws, chisels, and drills were tipped with "stones" that could have been nothing else than diamond, sapphire, or some variety of hard cutting alloy. The fact that the hardest stones were worked before 3,400 B.C. seems to disprove Mr. Hibbard's contention that "hardened steel is the only substance known to man which could have served the purpose. There is no other." For that was even before the day of copper.

It is definitely known that the Incas used bronze tools, for specimens have been found and analyzed. These tests show the material to be a form of silicon bronze, somewhat similar to our present-day hard bronzes. Also, it is pretty well settled that the Incas were of Asiatic origin, hence came from somewhat the same beginnings as the Egyptians. Both races worked hard materials with extreme success; both probably had silicon bronze tools. But the finishing cuts and incising of Egyptian work could not have been made with silicon bronze or with the kind of steel available to a nation without heating and control facilities of anywhere near the proper sort. All indications point to a still harder material. In the light of the evidence submitted, is it not logical to assume this material was flinty spots of the worked material itself, diamond or sapphire tips on copper, bronze, iron, or wooden handles, or lastly, a materials that tool steel itself cannot touch. Samples Small cutting bits of extremely hard material would be more easily lost, harder to get, consequently more highly prized than other materials, they were available before even copper was invented, hence explain the earliest works in hard materials, and lastly, are capable of cutting materials that tool steel itself cannot touch. Samples of "stone" tipped drills are pictured on tomb walls of before 3,000 B.C., but no steel can be found that antedates several centuries A.D. The best earlier examples are of iron, and poor iron at that.

The theory that steel tools were used in Egypt is by no means new. It has been propounded by almost every metallurgist or steel man who has visited Egypt, including Sir Henry Bessemer fifty years ago. That, in fact, is not the most unusual theory propounded. Only recently, a correspondent asked Mr. Lansing whether any evidence existed of machine tools in ancient Egypt. The rectangularity and planeness of surface of the stone sarcophagi made him think that they must have been done on a planer! The problem is largely the old story of the Egyptian visitor who, finding a bit of copper wire in a tomb, jumped to the conclusion that the Egyptians had known all the secrets of electricity. A companion, who found no wire, immediately concluded that the Egyptians had known the secrets of wireless telegraphy.

■

Blank Diameter—*Discussion*

CARL G. FORSAM

HAVING had many years' experience on drawing dies of different kinds, my way of developing blank diameter is similar to that described by T. Smith in an article in *American Machinist*, Vol. 74, page 59.

Before cutting the blank for the first try, I make a sample from the blue print and then cut the blank down until the two balance on a photographer's scale. This reduces the number of trys to begin with. If the blanks are circular, this method is very fast as a blank of the proper thickness can be held in a bench lathe while the circumference is turned or filed down until it balances with the sample. An approximate blank can be determined by this method for irregular shapes also, especially on deep drawing work where too large a blank would cause the metal to stretch.

I make my sample out of brass, which is turned in a lathe from the solid, or drawn up in a temporary die and trimmed. It can also be made in sections, and all the pieces weighed together to balance the blank. This method is quicker than the mathematical method for the average diemaker.

IDEAS FROM PRACTICAL MEN

Jig for Drilling Discharge Ports in Valve Guides

CHARLES C. TOMNEY
Tool Designer, Brunswick-Kroeschell Company

THE VALVE guide shown in Fig. 1 is chucked by the flange indicated by dotted lines. After it has been bored, turned, and reamed, the guide is cut off from the flange at *A*. The final operation is to drill four equidistantly-spaced holes through the smaller diameter, using the jig shown in Fig. 2. The body of the jig is cast iron, and the four sides are planed square with each other.

The body is counterbored to a diameter that will give clearance to the larger diameter of the work, and has a ¾-in. hole in the back wall. The work is held in the counterbored chamber on a central stud, the small part of which passes through the rear wall of the jig body. The stud is secured in place by a tapped handle, which acts as a nut. The outer end of the central stud is turned down and threaded, and carries a slotted clamp and a knurled nut, as shown. Drill bushings are let in flush with the sides of the body. In loading the jig, it is necessary only to lift off the clamp and to pass the work over the knurled nut and onto the larger diameter of the stud, seating it against the rear wall. Replacing the clamp and tightening the knurled nut holds the work securely in place.

In operation, the jig is placed with one of its sides on the table of the drill press, and a hole is drilled through the bushing at the top. After drilling the first hole, the drill is withdrawn and the jig is rolled over onto the next side. The second hole is then drilled through the bushing that is now at the top. The operation is repeated until all four holes have been drilled. The tapped handle is held in the operator's hand to prevent the jig from turning under pressure of the cut.

Fig. 1

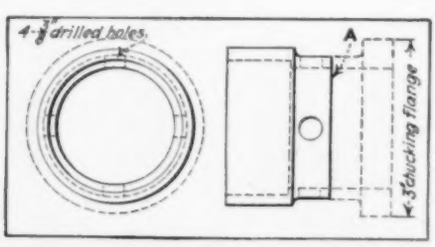
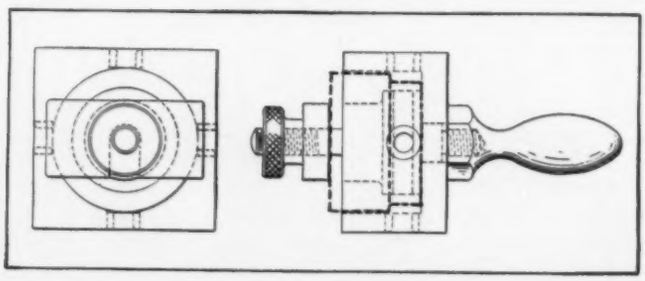


Fig. 2

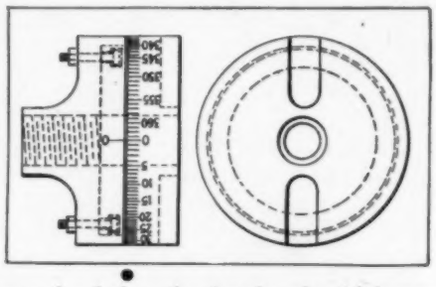


Cutting Multiple Threads—*Discussion*

CHARLES KUGLER

I was much interested in the articles under the title given above, on page 172, Vol. 73, and page 23, Vol. 74, of the *American Machinist*, by Harvey Chandler and James Pearman, respectively.

However, the method of indexing for cutting multiple threads shown in the accompanying illustration is, in my opinion, superior to either of the methods described in the articles referred to above. The ordinary small faceplate is recessed and an adapter having a pilot to fit the recess is held thereon by bolts, the heads of which are confined in a circular T-slot, as shown. The adapter is graduated in degrees and is provided with slots for the tail of the driving dog.



In indexing for multiple threads, the adapter is first set so that its zero line coincides with the zero line on the faceplate. The first thread is then cut. For the next thread the adapter is rotated on the faceplate as many degrees as the number of threads to be cut will be contained in 360. For each successive thread the adapter is rotated a like amount. Any number of threads can be cut that can be divided into 360 without a remainder.

Repairing Gears Having Broken Teeth *Discussion*

J. T. TOWLSON
London, England

Having read with some little interest the way in which one of your esteemed contributors, T. Smith, discusses the repairing of gears having broken teeth (see *American Machinist*, page 23, Vol. 74), I hope it will be in order for me to continue the discussion. It appears to be presumed that Mr. Smith possessed neither a milling machine nor a vernier tooth gage, but that he did possess a shaper.

It is thought that he "begs the question" just a bit when he says he used a narrow hacksaw to make the horizontal cut when cutting the piece of metal out of the gear. It would indeed have to be a narrow hacksaw, but there are other ways to cut such a piece of metal away. A way that is usually adopted is to cut down the sides of the dovetail first, and then saw down to the desired depth at a number of places between the two extremes of the gap. Then by a series of diagonal cuts, coupled with the discreet use of a hacksaw of standard width, the whole of the piece may be cut away, ready for smoothing with a file. Mr. Smith's method of templet

use is to my mind just passable, but rather a long way around. Why he neglected to use his shaper for shaping the teeth, passes my comprehension.

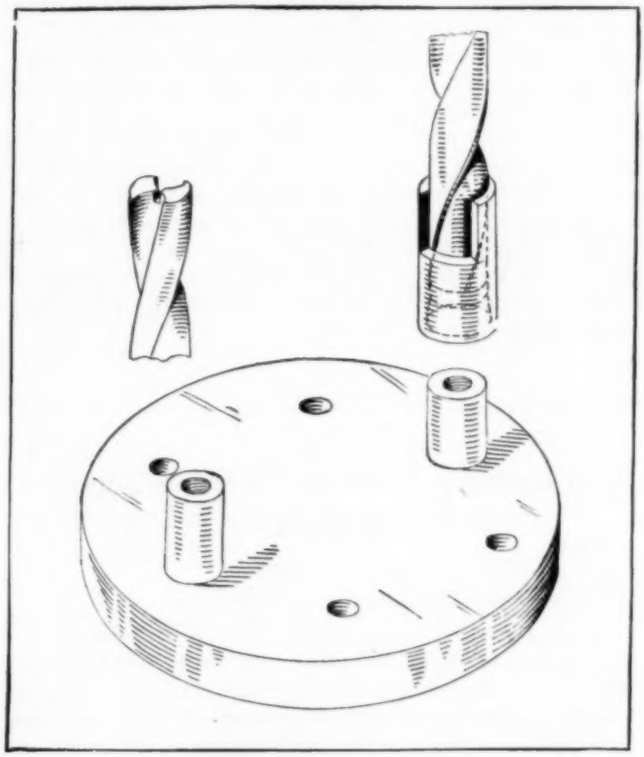
If he had just put the broken gear on a tight-fitting mandrel, and held that mandrel in V-blocks placed in a fore and aft position on the shaper table, and arranged for a spring plunger to function as an index pin (using the sound teeth as reproducers of necessary pitch), he would have saved all that unnecessary filing. A form tool in a spring bar, held in the toolpost, would have finished the teeth to correct form, as well as dead square.

■

Tool for Facing Studs

CHARLES H. WILLEY
Superintendent of Manufacturing
Hoyt's Electrical Instrument Works

Through a sudden change in the design of a part in one of our products that had already gone through a portion of its process, it became necessary to shorten certain studs that had been spun into metal bases. Since the



studs were of ¼-in. round brass and had holes tapped in them for 4-48 screws, it was obvious that a piloted tool could not be used. The problem was how to face off the studs without injury to the tapped holes.

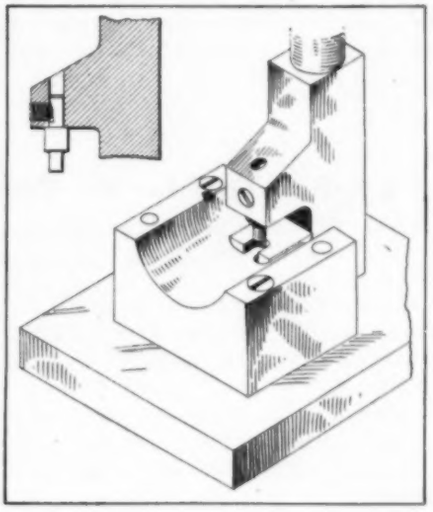
One of our toolmakers ground the end of a $\frac{7}{64}$-in. twist drill as shown at *A*, and then made a sleeve having two ears to fit it. The ears were bent inward so that they gripped the body of the drill, yet permitted the chips to flow freely in the flutes.

With the sleeve on the drill, as shown at *B*, the drill was lowered, the sleeve passing over one of the studs and acting as a guide. The flat end of the drill faced off the stud, the stop on the drill spindle having been set to gage the height.

A Horn-Press Perforating Die
Discussion

HENRY W. BOEHLY
Machine Designer, Mergenthaler Linotype Company

In an article under the title given above, on page 254, Vol. 74, of the *American Machinist*, S. A. McDonald describes a die for piercing pots in such a manner that the burrs will be on the inside. He states that the piercings pass up through the die and fall out through the clearance space provided for that purpose. In my experience, I have found that piercings do not always follow the course intended. More than once I have seen punches damaged by the piercings clogging up the passages intended for them, thereby causing resistance sufficient to bend or break the punches.



In the illustration is shown a set of tools that can be used for piercing pots so that the burrs will be on the inside. One advantage of these tools is that they can be used in any regular type of press, so that a horn press is not necessary. The die is mounted on a base plate having a rectangular hole to serve as a guide for the extension on the punch-holder. The stripper also serves as a stop for the work. The sectional view shows the method of holding the punch in the punch-holder. While but one punch is shown, provision can be made for any required number.

In operation, one side of the pot rests in the concave part of the die-block, while the other side clears the horizontal projection on the punch-holder. Such a set of tools has, at least, the advantage of being simple in construction and not being likely to cause trouble in use.

■

A New Use for Celluloid—*Discussion*

T. SMITH
Sutton in Ashfield, England

The very interesting article by J. F. Cavanagh, under the title given above, on page 788, Vol. 73 of the *American Machinist*, has given me the idea that perhaps some of the readers may be interested in still another use for celluloid.

In making embossing tools, the diesinker sinks the design into the die. Then if he can get hold of a sample embossed sheet, he likes to try the impression in the die to see if it fits. In the past, we ran molten solder into the die for a "proof." We have found, however, that a sheet of celluloid about ½ in. thick, cut to the size required,

placed in warm water to soften the surface, laid on the die and squeezed by a blow of the press ram and left until cold, will give a very good cameo impression of the design cut in the die. In fact, in many casess where the quantity of production was small, we have used such cameos in place of the punches, or "forces."

If the celluloid is used merely to check the impression in the die, it can be used many times on other dies by turning it over for each impression. After being used many times it will show cracks on the face. It is then of no further use. In cutting letters in a die, we often use Plasticine as a "proof." Plasticine is a modeling material used by children in learning to model. It is the best thing we have come across for our purpose, and we have found its use to save us many hours of work.

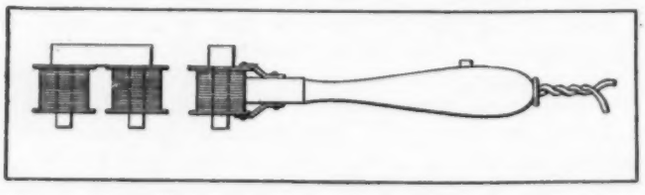
■

A Safety Tool for the Press Operator

VICTOR VAN ZEEBROECK
Antwerp, Belgium

In order to safeguard the hands of the press operator, it is a regular practice in our factory to have him use a pair of pliers for handling the work in and out of the press. Lately, however, we encountered some difficulty in applying this method of handling to parts of intricate form, and the operator was obliged to place and remove the work with his hands, constituting a dangerous practice.

To eliminate the accident hazard, I introduced a charging tool consisting of an electromagnet mounted on a long



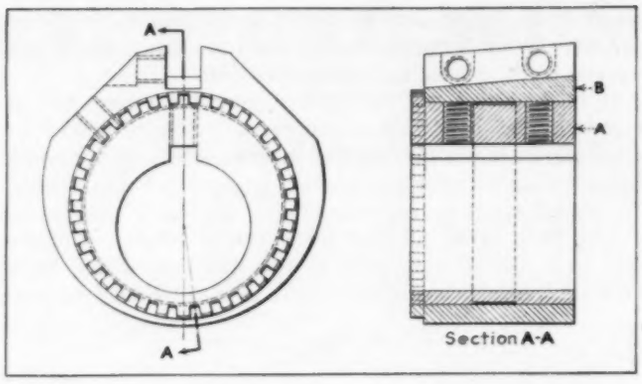
handle and connected to the lighting current, much in the same way as is an electric soldering iron. As shown in the illustration, the handle is provided with a suitable button switch, so that the current remains off until the button is pressed. When the current is on, the electromagnet is, of course, energized and will pick up parts of steel or iron. The device is now in general and successful use throughout the factory.

■

Adjustable Head for a Boring Bar

ELMER FELSKE
Toolmaker, Atlas Car & Manufacturing Company

The boring head illustrated was designed for use on a boring bar having a keyway along its entire length. The eccentric *A* has a series of teeth cut on a flange at one end. The sleeve *B* fits over the eccentric and has internal teeth to engage the teeth in the eccentric. An angular slot in the sleeve serves as a seat for the cutter, and its inclination is such that sliding the cutter along it advances the radial distance of the cutter point from the center of the bar about $\frac{1}{10}$ in. for each inch of travel.



It will be seen that by sliding the sleeve upon the eccentric so as to disengage the teeth, and by turning it and then sliding it so as to re-engage the teeth at various points, the point of the cutter will be varied in its radial distance from the center of the bar, accordingly. The eccentric is secured to the boring bar by two safety setscrews bearing on top of the key, and the sleeve is secured to the eccentric by a single setscrew of the same type. Since the teeth do all the driving, it is necessary only to bind these two members tightly enough together to prevent them from sliding one upon the other.

By adjustment of the sleeve on the eccentric, a variation of $\frac{3}{8}$ in. can be secured in the radial position of the cutter, corresponding to a variation of $\frac{3}{4}$ in. in the diameter of the hole bored. This adjustment need be made for rough boring only. For finish boring, the cutter is adjusted by sliding it in its angular slot. By having several cutters with ends bent at an angle, of various lengths, a large range of diameters can be bored. The cutters have lengthwise grooves ground at such locations in the sides as will cause the setscrews to draw them toward the bottom of the slot.

■

Checking Bushing Holes in Jigs
Discussion

JOSEPH E. ABBAZIA
Mechanical Instructor, Apprentice School
Yale & Towne Manufacturing Company

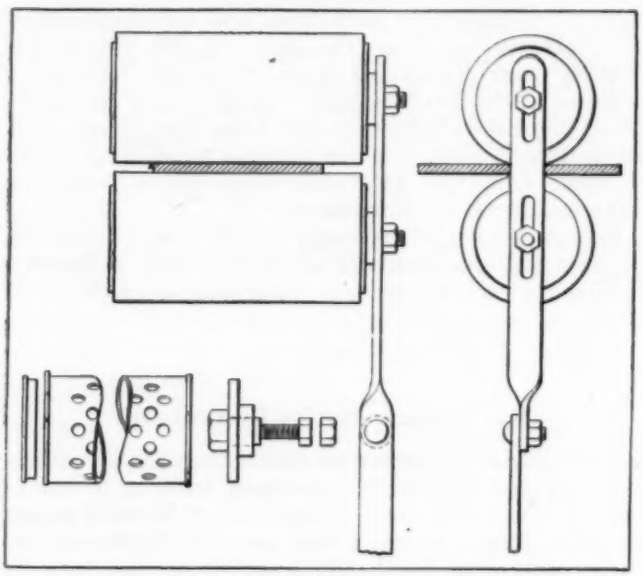
In an article under the title given above, on page 64, Vol. 74, of the *American Machinist*, Charles Kugler describes a method of checking bushing holes in jigs. While Mr. Kugler's method will work satisfactorily, he could have simplified the apparatus somewhat. By clamping the indicator directly to the movable jaw of the vernier caliper, or to that of the height gage, using a very small clamp, the base and the upright of the surface gage could have been dispensed with. The indicator button could be brought into contact with a gage block placed on the surface plate and the indicator adjusted to read zero.

The distance between the center of the hole and the base of the jig would be found by adding together the measurement recorded when the indicator button touched the gage block, the distance from that point to the lower edge of the hole, one-half the diameter of the hole, and the height of the inner part of the stationary jaw from the surface plate.

Stock Lubricator

F. J. Wilhelm

An inexpensive lubricator for punch press strip stock may be made using two friction lid tin cans. These are perforated and covered with ½-in. felt. A boss is soldered centrally in each can bottom to act as a bearing. The cans are mounted on a slotted bracket by nuts, washers, and two special studs. It is best to adjust the lower roll to the desired height and allow the upper one to remain loose in the slot so its weight will rest on the stock. The bracket can be bent and fastened to the punch press in a convenient position. A hinged joint in the bracket enables the operator to swing the rolls to a vertical position when filling them with oil. Small blanks may also be lubricated in this way when deep drawing operations are to be performed.



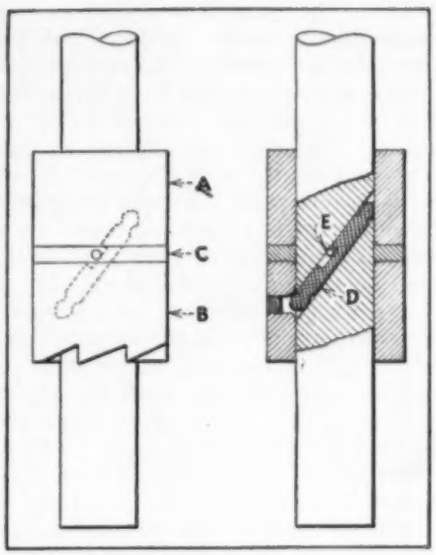
■

A Quick-Change Spot-Facing Tool

Harry Moore
Hamilton, Ontario, Canada

More often than not it takes a longer time to change a roughing spot-facing tool for a finishing one than it does to do the facing itself. Methods of changing the cutters may be of the simplest nature, but if the machine must be stopped while making the change, the time required will be too great a proportion of the total time to do the work. It was the necessity for stopping the machine to change cutters that prompted me to design the tool shown in the illustration.

The bar of the tool is of the same diameter as that of the reamed hole in the work, around which the boss is to be spot faced. Both the collar *A* and the cutter *B* are sliding fits on the bar, while the washer *C* is a tight fit. A hole is drilled diagonally through the bar, and the pin *D*, which is a loose fit, is of such length as will bring its ends flush with opposite sides of the bar. This pin is rounded at both ends and has a flat in the center, so that the small pin *E* will prevent it from falling out of the hole when the cutter is removed. In one side of the cutter is a hole having the edges rounded on the inside. The inner edges of the large holes in both the collar and the cutter are rounded at the ends where these members contact with the washer.



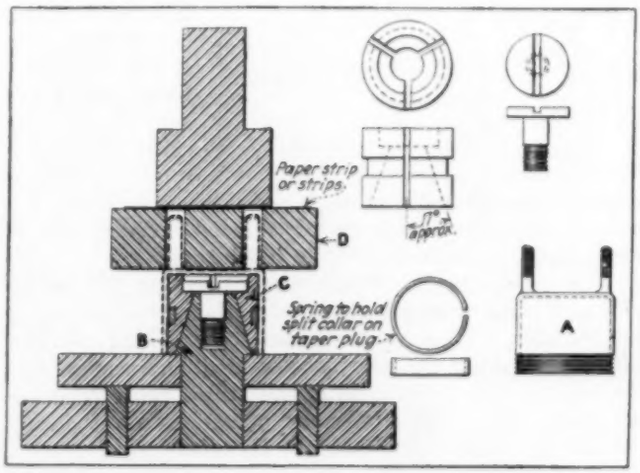
In operation, to remove the cutter without stopping the machine, the collar *A* is grasped by one hand and lifted clear of the pin *D*. The cutter is grasped by the other hand. Since the cutter ceases to revolve with the bar, the pin *D* is forced out of engagement with the hole in the cutter, leaving the cutter free to be removed from the bar. To replace the cutter with another, the cutter is entered on the bar and is pushed up against the washer, the collar still being held up. Holding the cutter so that it does not revolve with the bar, the collar is pulled downward until the pin *D* comes into engagement with the hole in the side of the cutter, where it acts as a key. A lead plug in the outer part of the hole in the side of the cutter keeps out the dirt and chips.

■

Expanding Threaded Shells

John P. Hoag

In threading oil-pressure shells, such as the one shown at *A*, a quantity of them had the threads cut a few thousandths undersize, some more, some less. In order to salvage them we made the press tools shown in the illustration. The shank of the taper plug *B* is a press fit in the die-shoe and a slip fit in the pressure plate. The collar *C* is bored to fit the taper plug and is split in three parts, the parts being held together by a flat spring seated in a groove. This split collar is placed over the taper plug on which it is confined by a large-headed



screw. The plate *D* is drilled to receive the threaded stems on the work. A flat, blank punch fitted in the punch-holder completes the equipment.

In operation, the part to be expanded is placed over the split collar and the plate *D* is put over the threaded stems. The press was adjusted so that the blank punch contacted lightly with the plate *D* when the ram was at its lowest point. Instead of adjusting the press for the difference of expansion wanted for the various pieces, strips of paper were placed between the blank punch and the plate *D*. It will readily be seen that when the ram descended the work was pushed down an amount equal to the thickness of the paper strips, carrying with it the split collar, and, as the split collar moved down on the taper plug, the work was slightly expanded.

More or less of the paper strips were used according to the amount the shells were to be expanded, it being much easier to vary the number of the strips than to adjust the stroke of the press for each variation of expansion needed. As the ram ascends, the springs of the pressure plate carry the split collar upward on the taper plug, permitting it to be collapsed by the flat spring. These simple tools, employed as described, more than paid for their cost by the number of pieces salvaged.

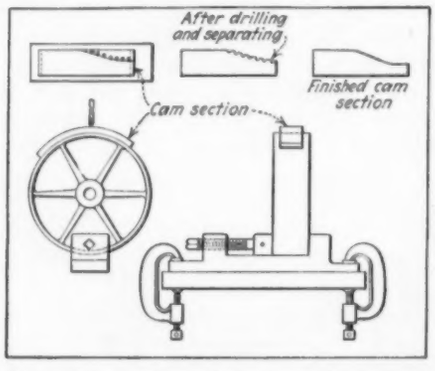
■

Altering a Section of a Protean Cam

A. VAN VEEN
Mechanical Engineer

It is sometimes necessary to alter the shape of one or more sections of a protean cam, such as is used in some types of automatic screw machines, so as to change the path of the cam roller. Recently it was necessary in a small plant to make alterations in one of the sections of such a cam. Since the plant had no cam-cutting facilities, the following simple method was employed:

After laying out the new path on the section, the piece to be cut off was separated from the section by the well-known method of drilling a series of holes. Since the section was curved to fit a 10-in. cam drum, it was necessary to rest the section on a similarly-curved surface while doing the drilling. A 10-in. straight-faced pulley was held in the machine vise, the unit being clamped on the table in such position as to bring the center line of the pulley directly under the center line of the spindle, as indicated in the illustration.



The section to be drilled was placed on the pulley rim and positioned for the various holes by moving it on the rim. Thus all the holes were drilled radially. After separating the piece not wanted, the section was dressed tangent to the radii of the drilled holes by grinding and filing. The different operations on the cam section are plainly indicated in the illustration.

SEEN AND HEARD

●

Pampered Steel

SEVERAL years ago this January, I almost froze my fingers off taking inventory of steel stock in an unheated storeroom where the doors had to be kept open to let in enough light to see what we were doing.

In a well managed storehouse, steel is no longer cold, but is pampered—kept warm all winter long. At least that's the condition in Ryerson warehouses—and for a reason. Cold steel condenses moisture in the air and rusts; warm steel stays dry and shows no tendency to deteriorate. In one section where bands are stored, steam coils are run directly under the racks where they are most effective with the least consumption of steam. In another room where galvanized black sheets and special sheets are kept, exhaust air from the office, distributed evenly through ducts discharging at the floor, keeps the temperature above the dew point. Before being placed in the racks, cold sheets unloaded from freight cars are warmed up in a steam heater box and the chill taken out of them. Otherwise they would immediately "sweat" in the warm air of the store house.

Cold rolled stock is not only stored in heated sections but kept well swabbed with oil at all times. Using two pockets for each size prevents accumulation of old stock at the bottom of the pile. —*S.*

Gas Welding Outfits Everywhere

GAS WELDING knows no special language or nationality, nor does it seem to have many limits as to industries in which it is used. I have seen it in small repair shops in Japan, Korea, China, and the Phillipines, on sugar plantations in Honolulu and Cuba, and even in the repair shop of an orange grower on a semi-tropical island. A list of the uses as well as the geography of the shops using such outfits would be of interest. As the editor of a small paper replied when asked where his paper circulated, "It goes all over the map and we have a hard time keeping it from going to hell."

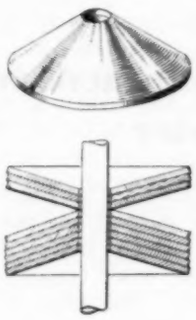
Gas welding may even find a place there according to the older theologies. —*J.R.G.*

One Sock and She's Put!

MECHANICS trained in the old school, where careful fitting without much regard to the time it consumed was taught, often disdain the use of a hammer for assembly operations. In the modern assembly plant, however, the hammer proves most useful.

A case in point was observed recently on a Ford assembly line where grease-gun fittings for spring shackles and similar parts are now driven home by using a hollow punch and a hammer. Formerly these fittings were threaded for screwing into a tapped hole, but today neither the fitting nor the hole is threaded. The shank of the fitting is made a drive fit in the hole and one blow of the hammer drives it home. Besides reducing the cost of assembly, the cost of cutting threads is saved, and the finished job answers all requirements. —*N.*

Belleville Spring Washer Formulas



SINCE the publication of an article on page 211, Vol. 73, of *American Machinist*, regarding Belleville spring washers, used on the Continent instead of helical springs, a number of requests have been received for further information. These requests have resulted in several subsequent items. Press tools for the manufacture of this type of washer were described on page 211, Vol. 73, and the load required to flatten various sizes was there tabulated. On page 710 of the same volume, the composition of a typical material for this type was given, together with suggestions for heat-treatment and fabrication. On page 897 was presented a table of properties of 133 sizes of washers. Herewith are given formulas for their calculation. They are not at present available in handbooks or other technical works.

It must be understood that the formulas are only applicable when certain proportions are given to the washers. These vary slightly with the washers, and should be as follows:

Given D as the outside diameter. When D is greater than 250 mm. and less than 300 mm. then d, the diameter of the hole, is approximately one-third D, the thickness of the stock e is approximately one-fifteenth D, and the height of the dome f is approximately 5 mm.

For D = 150/250 mm., f = 4 mm., d = one-third D, e = one-twentieth D.

For D = 100/150 mm., f = 3 mm., d = two-sevenths D, e = one-thirtieth D.

For D = 30/100 mm., f = ½ mm., d = two-fifths D or one-third D, and e = one-fifteenth D.

When the proportions differ greatly from those given, special calculations must be made that are both long and tedious, as well as unreliable. The best procedure in such cases is trial and error.

Given the principal dimensions, a close approximation of washer dimensions can be arrived at. Since all previous calculations were given in C.G.S. units, the same system of notation will be used here. They may, however, be transposed into American units by using these factors:

1 in. = 25.4001 mm. 1 lb. = 0.4536 kg.

In C.G.S. notation:

P = load in kilograms D = outside diameter in mm.

f = height of dome in mm. e = thickness of stock in mm.

R = radius of washer $\left(\frac{D}{2}\right)$ $\pi = 3.1416$

E = 22,000 kg., the modulus of elasticity in C.G.S. units.

$$f = \frac{117PR^2}{64\pi Ee^3} \qquad D = \sqrt[3]{\frac{64\pi Efe^3}{117P}} \qquad e = \sqrt[3]{\frac{117PR^2}{64\pi Ef}}$$

$$P = \frac{64\pi Ee^3}{117R^2}$$

If the first washer in the table of sizes on page 897, Vol. 73, of the *American Machinist*, is used as an example: D = 300 mm., d = 100 mm., e = 20 mm., f = 5 mm. These agree with the stipulated relations, since $\frac{d}{D} = \frac{1}{3}$, $\frac{e}{D} = \frac{1}{15}$ and f = 5, as the dimension D is greater than 250 mm.

Using P as 60,000 kg., and applying the formulas to check the accuracy:

$$f = \frac{117PR^2}{64\pi Ee^3} = \frac{117 \cdot 60{,}000 \cdot 150^2}{64\pi \cdot 22{,}000 \cdot 20^3} = 4.5 \text{ mm.}$$

$$D = 2\sqrt{\frac{64\pi Efe^3}{117P}} = 2\left(\frac{64\pi \cdot 22{,}000 \cdot 5 \cdot 20^3}{117 \cdot 60{,}000}\right)^{\frac{1}{3}} = 317 \text{ mm.}$$

$$e = \sqrt[3]{\frac{117PR^2}{64\pi Ef}} = \left(\frac{117 \cdot 60{,}000 \cdot 150^2}{64\pi \cdot 22{,}000 \cdot 5}\right)^{\frac{1}{3}} = 19.25 \text{ mm.}$$

$$P = \frac{64\pi Ee^3 f}{117R^2} = \frac{64\pi \cdot 22{,}000 \cdot 20^3 \cdot 5}{117 \cdot 150^2} = 67{,}000 \text{ kg.}$$

From the foregoing it is shown that the formulas hold good for such washers. If another washer of, say, 80-mm. D, 7-mm. e, 7,500-kg. P, 26-mm. d, and 1-mm. f is taken, the equation is:

$$P = \frac{64\pi Ee^3 f}{117R^2} = \frac{64\pi \cdot 22{,}000 \cdot 7^3 \cdot 1}{117 \cdot 40^2} = 8{,}100 \text{ kg.}$$

Several washers can be arranged to support a load that would normally be supported by one washer with an outside diameter too large to fit the design. Thus two washers which could support a load of 7,500 kg. measure 160 mm. and 150 mm. respectively with a thickness of 7 mm. and holes of 56 mm. diameter. Washers can be nested thus to take any desired load within reason. The loads to which washers are subjected should never exceed two-thirds the calculated load.

Contributed by James R. Cornelius, Coventry, England.

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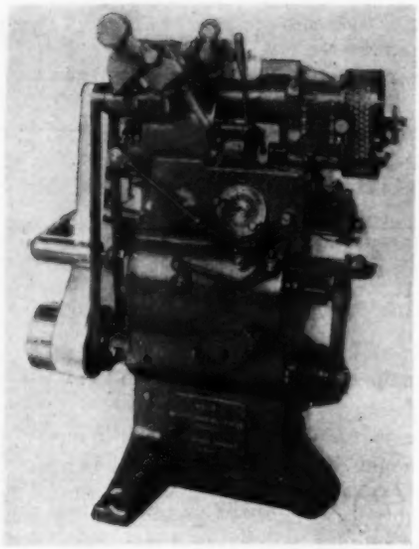
SHOP EQUIPMENT NEWS



Bryant No. 3 Chucking Grinder, showing the automatic sizing box for the electric automatic sizing equipment

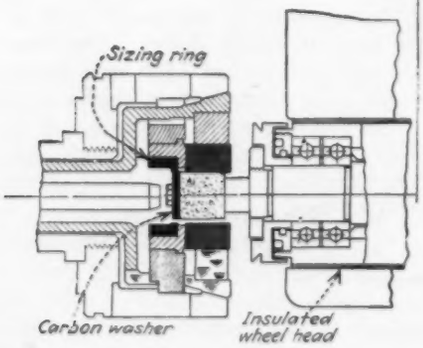
Automatic Electrical Sizing Equipment for Bryant Chucking Grinder

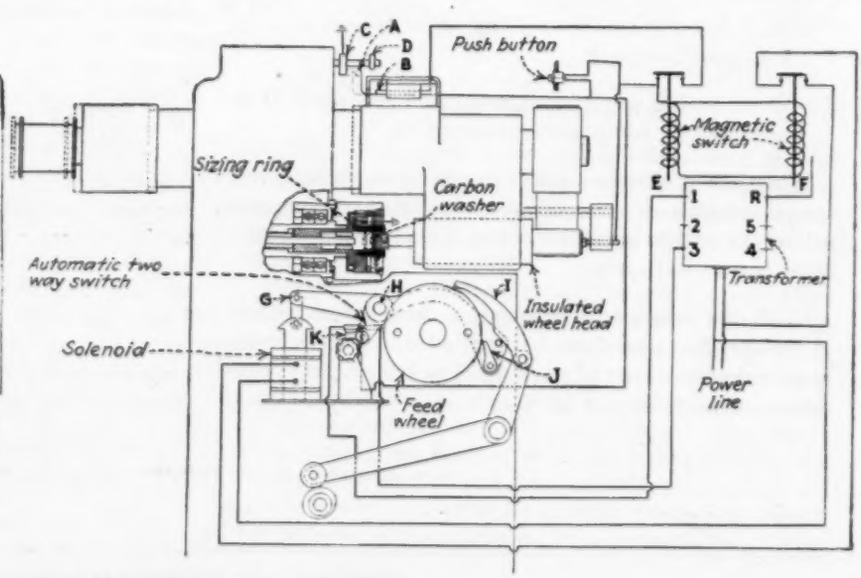
CONTACT between a carbon washer adjacent to the grinding wheel with a carbon sizing ring mounted in the chuck causes the automatic electric sizing equipment, developed by the Bryant Chucking Grinder Company, Springfield, Vt., to function so as to back off the feed. The carbon washer and wheel being mounted side by side are dressed by the diamond to the same diameter, and as the wheel is worn down by contact with the work the carbon is worn equally. The sizing ring and work are grounded electrically through the chuck so that the chuck is not complicated by the necessity for insulation. This sizing ring is easily replaced and forms a part of the backing spider, its design depending upon the type of chuck. Since the sizing ring is grounded to the bed of the machine, it is necessary to insulate the carbon washer from the bed. This is done by insulating the wheelhead as a unit from the slide box. Current is carried to the spindle by a brush, and no current passes through the spindle bearings.

It is not necessary that actual physical contact be made between the carbon washer and the sizing ring, and there is never contact between the grinding wheel and the sizing ring. By applying different voltages it is possible to knock off at different sizes. By applying a relatively high voltage for rough grinding, the feed is knocked off at a predetermined rough size, and then after dressing the wheel, a lower voltage may be applied to cause the feed to knock off later at the finished size. The change from one voltage to another is made automatically or by hand. In order to prevent the device being tripped off by current leaking through the coolant, the magnetic switches are arranged to require a heavier current for operation than that which might leak through before the work reaches the predetermined size. The voltages are readily adjusted and range from 5 to 20 volts. Current is provided by a transformer when an a.c. source is available. When d.c. power is employed the voltage is cut down by resistance.

When the work has been ground to size magnetic switches are closed, causing the solenoid to be energized. These switches are arranged to remain closed until the operator withdraws the slide from the grinding position, after which they are released automatically. Grinding having been stopped, the operator withdraws the wheel from the grinding stroke to dress the wheel or permit another piece to be chucked. This operation automatically de-energizes the solenoid, which is then latched so that the parts do not resume the grinding position until the operator advances the feed wheel by hand after having

Fig. 3—Below—Diagram showing the carbon ring and carbon washer that form the contact members of the electrical sizing control. Right—Wiring diagram of the Bryant automatic electrical sizing equipment for chucking grinders. The wheelhead is insulated from the slide





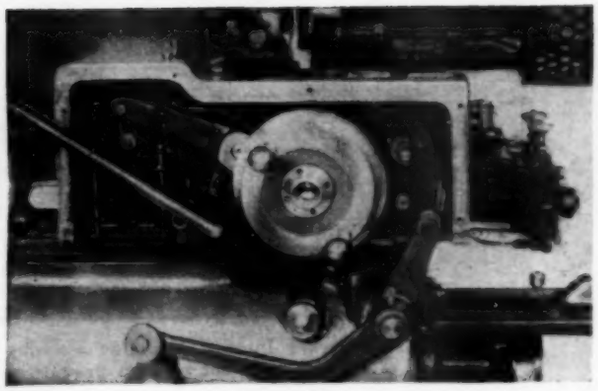


Fig. 2 — Close-up of automatic sizing box after the feed pawl has been disengaged and the wheel relieved

brought the grinding wheel into the grinding position. At this time the voltage across the carbon washer and the sizing ring is automatically changed for the finish size. It is obvious that this change is not made when the work is ground to finish size in one operation.

This automatic electrical sizing device is particularly applicable to the No. 3 grinder, which is so proportioned that two machines may be placed at right angles to one another. Thus, the operator need not step away from the first machine to operate the second. To change jobs it is necessary only to change the sizing ring in the chuck. The equipment is being applied on new machines, and is also being attached to machines already in service.

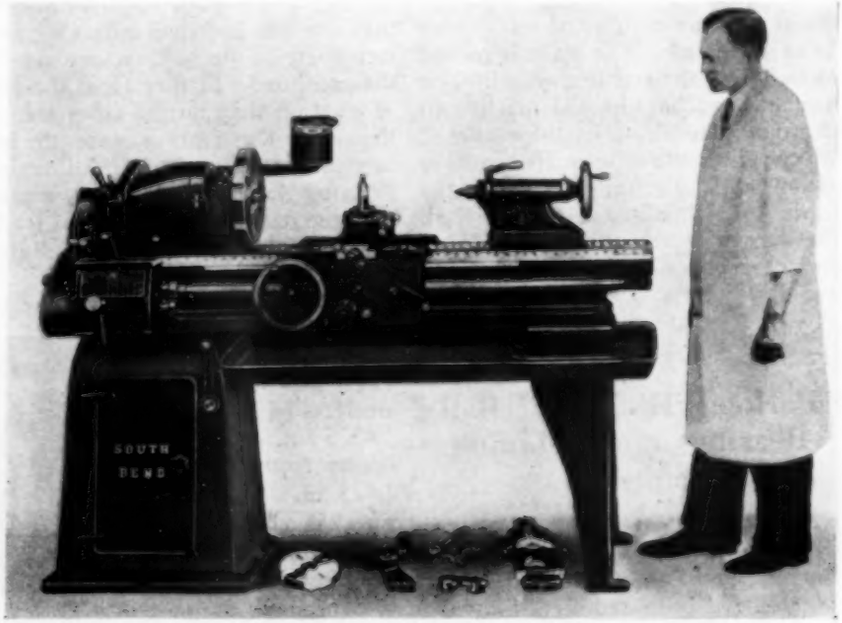
South Bend Series N Lathes With Underneath Motor-Belt Drive

A back-geared, screw-cutting, precision lathe featuring an underneath motor-belt drive has been placed on the market by the South Bend Lathe Works, South Bend, Ind. This lathe is known as the series "N" and is provided with a motor inclosed in the cabinet leg under the headstock. It is offered for production work, precision toolroom work, and general machine shop use. It is built in sizes from 9 to 18-in. swing and in bed lengths from 2½ to 14 ft.

By mounting the motor in the cabinet leg, clear vision and freedom from overhead obstruction are obtained. Two adjustable V-belts connect the motor with the jackshaft. A flat leather belt, which also can be adjusted, connects the driving cone on the jackshaft with the spindle cone on the headstock. Eight speed changes are provided through the 4-step cone and the backgears. Adjustment of the flat belt is controlled by a cam in the cabinet leg, directly in back of the belt adjusting lever.

All moving parts that can be protected are so covered in order to insure safety to the operator. There are no exposed belts, pulleys, or gears. An automatic safety interlock prevents the automatic longitudinal feed from being engaged while the split nut is clamped on the leadscrew for cutting screw threads. A drum-type reversing switch stops, starts, or reverses the reversing motor. A single clutch knob operates both the automatic cross feed and the automatic longitudinal feed. Changing from one to the other is obtained by means of a sliding gear in the apron. The front end of the spindle is ground and the spindle bearings are of phosphor bronze or cast iron, an optional feature. The headstock is bolted directly to the lathe bed.

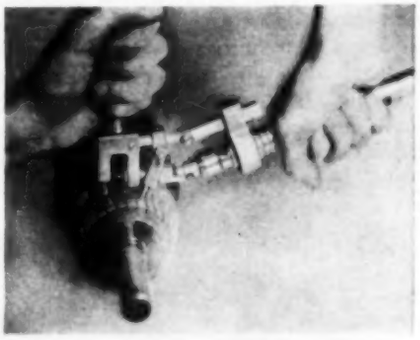
The tailstock is equipped with a graduated spindle and the center is made of tool steel, hardened, tempered, and ground. It is self-ejecting. The lathe bed is a semi-steel casting reinforced by box braces.



Underneath Motor-Belt Drive is employed in the South Bend Series N Lathes to achieve quiet operation and elimination of vibration

"Kellerflex" Mica Undercutter

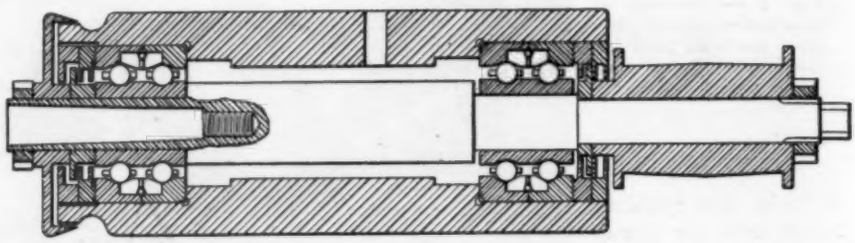
For undercutting mica on the commutators of industrial motors, the Keller Mechanical Engineering Corporation, 70 Washington St., Brooklyn, N. Y., has introduced the "Kellerflex" mica undercutter. It can be furnished in a suspended type, on a 6-in. bench stand, or on a low roller



floor stand. The ball-bearing motor is of ¼ hp., and suitable for use on 110 or 220 volts. It is mounted in a universal swivel yoke. The flexible shaft is ⅛ in. in diameter by 5 ft. long. A ¼-in. collet is furnished. The ball-bearing handpiece carries 1- or 1⅛-in. V- or U-type cutters. The cutting

spindle runs in two oil-less bearings.

The driving shaft, which is chucked in the collet, has a universal joint so that the device may be used on commutators of railway and industrial haulage motors without dismantling them. An adjustable depth gage and two guide rollers with angular adjustment are provided. These may be adjusted for work on commutators varying from 4 to 24 in. in diameter, so as to cut to any desired depth.



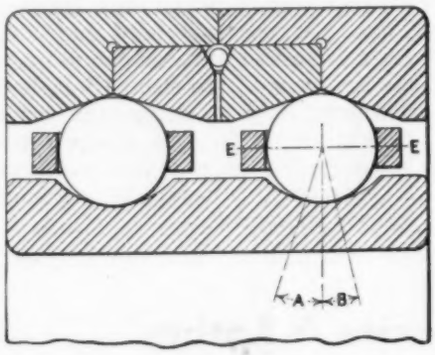
Cross-section of Parker Internal Grinding Spindle fitted with "Hi-Speed" ball bearings for modern production speeds

Wells No. 112 Grinder for Power Hacksaw Blades

For sharpening power hacksaw blades, especially those of the high-speed steel type, the Wells Manufacturing Company, P.O. Box 613, Greenfield, Mass., is introducing the No. 112 grinder. This machine will sharpen any width and any length of blade, and any number of teeth from 14 to 4 per inch. The blade is rocked to and from the grinding wheel. The machine can be adjusted to sharpen alternative teeth at opposite angles, which gives the saw a free cutting action and the effect of a set in the teeth. A ½-hp. motor is furnished, together with two wheels for fine- and coarse-tooth saws, and one diamond.

Parker "Hi-Speed" Ball Bearings and Grinding Spindles

Four-point contact of the balls on the raceways is a feature of the Parker "Hi-Speed" ball bearings, which have been redesigned by the Majestic Tool & Manufacturing Company, Detroit, Mich. These bearings are built especially for use with integral grinding spindles, and are made in eight sizes. To eliminate crushing of the oil film, which is usually the principal cause of overheating at high speed, the four-point contact design has been evolved. From the sectional drawing, angle *A* is greater than angle *B*, and thus causes the contact point of the ball, on one side of the race, to be farther from the axis of rotation than on the other side of the race. This feature causes the ball to rotate in a slightly spiral direction, bringing the entire surface in contact with the raceways. Wearing of tracks or flat spots on the balls is thus eliminated.



Cross-section of Parker "Hi-Speed" Ball Bearing, showing that the angle *A* is greater than angle *B*, in order to cause spiral rotation of the balls and thus minimize wear

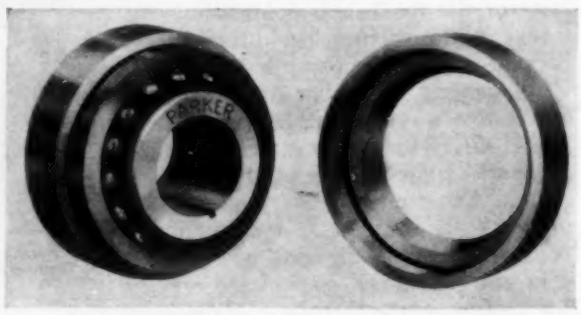
These "Hi-Speed" ball bearings are built in eight sizes with bores of 0.375 to 1.625 in., over-all diameters of 1.125 to 3.4375 in., and thicknesses from 0.750 to 1.625 in. The inner race has a keyway.

The line of internal grinding spindles has also been re-designed for the higher speeds now in use. The accompanying cross-section shows one of the typical designs. All of these spindles are pulley-driven, some having outboard bearings and some not.

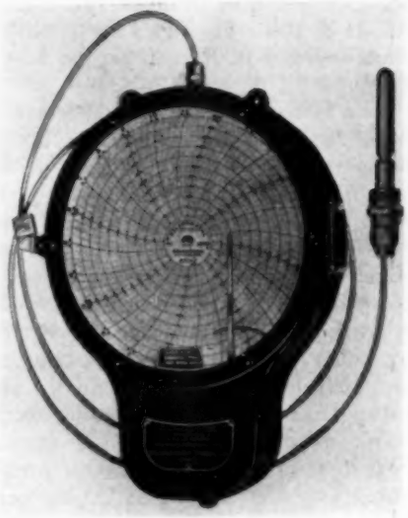
Tycos Compensated Tubing for Temperature Instruments

To eliminate error in the functioning of temperature instruments, particularly from the effect of external temperature conditions surrounding the tubing connecting the bulb to the instrument itself, the Taylor Instrument Companies, Rochester, N. Y., have produced a capillary tubing with compensating qualities. These qualities are incorporated in the material of the tube itself. No parts are added to the mechanism of the instrument, and no adjustments are necessary.

Essentially, the method consists of so proportioning the volume of mercury in the tubing to its co-efficient of expansion and to the size of the alloy wire, that any change in the volume



Parker "Hi-Speed" Ball Bearing, which has V-type raceways to give four-point support for the balls



"Tycos" Recording Thermometer with compensated tubing

of mercury, resulting from external temperature changes, is accurately compensated. For this reason, the adjustment is made for each varying exposure, and it is not necessary to compensate the instrument for the average external condition along the length of the tubing, a feature which is almost impossible to undertake. The tubing is 7/32 in. outside diameter and employs welded joints.

Oliver Double-Spindle Wood Shaper

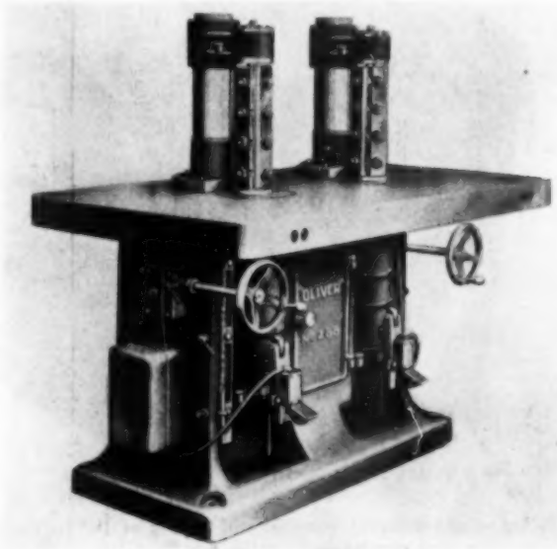
A double-spindle wood shaper is being offered to the trade by the Oliver Machinery Company, Grand Rapids, Mich. This machine is similar to the No. 287 shaper, but has double spindles, and is especially suitable for heavy-duty, autobody or pattern-shop use. The machine is capable of producing any kind of rabbetting, grooving, fluting, routing, and shaping.

The 11-in. holes in the table are fitted with three rings, the smallest being 2 in. The spindles and motor units, sliding on gibbed ways, can easily be drawn up through the 11-in. holes. The table measures 66x36 in., and the spindles are placed at 24 in. centers. Exhaust pockets are cast on the underside of the table and back of each spindle to catch the dust which escapes below the cutting line. The table is tapped for securing shaper guards.

The detachable ball-bearing spindles are of the precision type. By removing four capscrews from the retaining ring, both bearings with the spindle may be pulled out through the hole in the top of the table. Oil level indicator gages are applied at each bearing. The top of each detachable spindle is tapered to receive the adapter spindle, which is held in place by a capscrew extending through the adapter and into the spindle. This taper construction is claimed to assure better spindle balance and centering. The standard spindle adapter is 1¼ in. in diameter and 8 in. long where the knife collar fits, but any practical size of detachable spindle can be furnished.

Ball-bearing fan-cooled motors are used when motor drive is specified. In addition to countershaft belt drives, three types of motor drives are included: Motor-on-arbor, belted motor drive, and V-belt motor drive. The motor-on-arbor type requires the use of a frequency changer to step up the frequency to 100, 120, or 140 cycles to obtain speeds of 6,000, 7,200, or 8,4000 r.p.m. Two 5-hp., 3,600 r.p.m. ball-bearing motors, mounted in a vertical position on machined cast-iron bases, drive the endless fabric belts in the belted motor drive. In the V-belt motor drive the arrangement is somewhat similar. The last type requires no more floor space than the motor-arbor type. At the same time it requires no frequency changer.

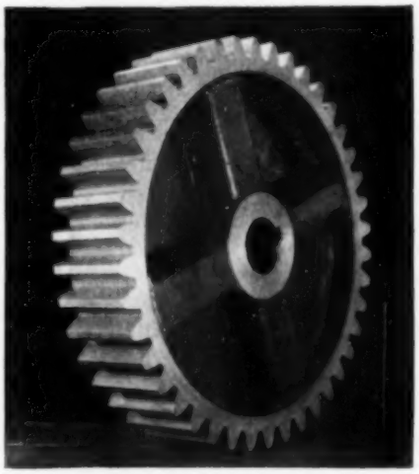
The vertical spindle adjustment is 6 in., the spindle length at collars, 8½ in., the diameter, 1¼ in. at the collars. Distance from the front edge of the table to the spindle is 18 in., side edge of table to the spindle, 21 in. The height of the table from the floor is 36 in., and the floor space required is 52x26 in., plus 24x32 in. when the countershaft is specified.



Oliver Double-Spindle Wood Shaper, which is particularly suited for heavy-duty, autobody or pattern-shop use

"Philweld" Gears

Welded steel gears ranging in diameter from 15 to 168 in. are now being manufactured by the Philadelphia Gear Works, Erie Ave. and "G" St., Philadelphia, Pa. These gears are especially adapted to heavy-duty service. They have about 50 per cent greater tensile strength than cast gears, weigh 10 per cent less, and



"Philweld" Welded Steel Gear, having the rim, center plate, and channel-shaped arms fabricated from steel plate and the hub from forged bar

give longer service life. The design is such that they produce a good appearance, all smooth welded beads being so located as to be unnoticeable.

Rolled S.A.E. 1040 steel plate is used for the rim, center plate, and arms. The center plate and rim are cut from plate by means of a gas

torch. The arms are formed into channels from the same plate, cut to shape, and welded to the center plate and the rim. The hub is cut from forged steel bar and drilled to receive the shaft. After all welding is done, the fabricated gear is normalized to remove all strains and the teeth in the rim are cut. As a result, an entirely homogeneous and balanced gear is obtained, and the dense non-porous character of the steel assures long wear on metal-to-metal contact and uniform strength of the teeth.

"Philweld" gears are available in spur, helical, herringbone, bevel, spiral, and Sykes continuous-herringbone types. They are also available in the company's line of heavy-duty speed-reducer units.

"Metalwash" Rotary-Drum Washing and Drying Machine for Metal Parts

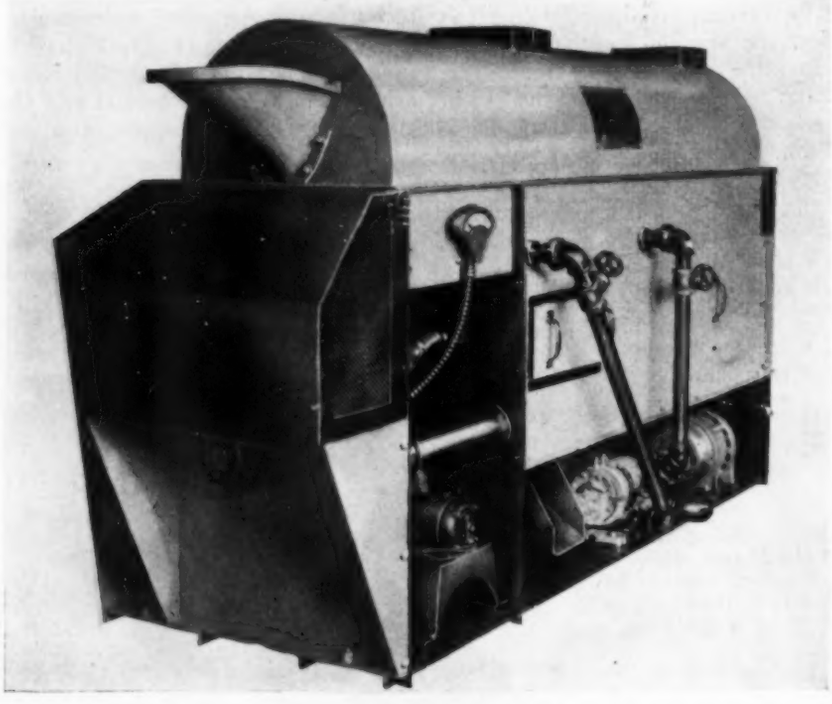
A completely automatic washing, rinsing, and drying machine has been developed by the Metalwash Machinery Company, Inc., 117-119 East 24th St., New York City. It is a rotary-drum type machine, combining three distinct functions in one unit for removing grit, dirt, oil, foreign liquids and chips from screw machine parts, stampings, and small castings. It is used before or after plating, burnishing, or acid dipping, and for cleaning before paint finishing or between various factory operations.

The machine operates on a rotating principle, requiring only one operator. He dumps the work into a loading chute. The helical screw in the perforated drum guides the material past the wash and rinse sprays, causing it to be automatically discharged into the dryer drum, which returns the clean and dry material close to the loading station. There it is automatically discharged into a container. If it is desired to wash and rinse the material only it can be discharged at the end of the rinse section into containers by a specially constructed chute by-passing it from the dryer drum.

The machine will clean and dry 100 to 240 cu.ft. of material per 8-hr. day, the total weight produced depending on the character of metal parts. It occupies 40 sq.ft. of floor space and stands 5 ft. 6 in. high, the loading chute being 4 ft. 8 in. from the floor level.

The machine housing is constructed of sheet steel, the removable hood being reinforced by angle irons with vent outlets. Tank seams are riveted and welded. Gear guards are provided where necessary. The rotary drums are constructed of perforated sheet steel with helical screws welded solid. Drums are supported by rollers mounted on drive shafts and driven from the outside by an arrangement of sprockets and steel roller chains connected to a speed reduction unit. Nozzle mouth pressures may be as high as 20 lb. per sq.in.

The drying system provides for hot-air recirculation by a motor-driven exhauster through radiating-fin booster coils. The heating system for the wash tanks is adapted for steam coils. Where electric heat is desired, wash tanks are equipped with electric immersion heaters and the dryer with electric air heaters. For gas heating, a special submerged heating system is supplied. Constant speed drive for the drums is provided, but variable-speed equipment can be supplied. Lubrication is provided through an Alemite greasing system.



Automatic washing, rinsing, and drying of 100 to 240 cu.ft. of parts can be handled per 8-hr. day with the "Metalwash" Rotary-Drum Machine

Krupp "Mikrotast" Snap Gage

In addition to "Mikrotast" saddle gages, the Coats Machine Tool Company, Inc., 110 West 40th St., New York, N. Y., is placing on the market a Krupp Mikrotast snap gage. While saddle gages straddle the work over a 3-point contact, and can only be applied to cylindrical parts not in motion, this gage can be applied also to rotating work. To offset abrasive action of rotating bodies, all contact points are faced with "Widia" cemented tungsten-carbide. There are two round "Widia" contact pads each on the lower anvil and on the backstop, thus insuring correct seating on the work. The measuring contact lever is located diametrically opposite to the lower anvil. This lever contacts with the work under spring pressure and is also equipped with two round "Widia" contact pads.

These gages are set to master plugs

or to work pieces of sufficient accuracy to warrant their use as a master for comparative measurement. They are adjustable in range, since the lower anvil can be let out towards the snap gage center and locked in any position. The backstop is likewise adjustable away from or towards the snap gage center.

Mikrotast snap gages are made in the following five capacities: 0.787 in. to 1.378 in.; 1.378 in. to 1.968 in.;

1,968 in. to 2.756 in.; 2.756 in. to 3.543 in.; 3.543 in. to 4.724 in.

Any standard Mikrotast Indicator will fit these snap gages. Specially recommended for use in connection with this gage are the graduations of 30x0.0002 and 30x0.0005 in., with scale ranges of 0.006 and 0.015 in., respectively. Red tolerance markers are provided for outlining plus and minus limits and may be set from without the indicator housing by rotating two knurled nuts located on the back of the housing.

Paulus "Cleancut" Guide for Shape Cutting

A guide for shape cutting is being produced by Jos. C. Paulus & Company, 2507-9-11 Potter St., Philadelphia, Pa. The machine is designed to meet the requirements of firms which desire clean, accurate cutting in too small quantity to warrant the purchase of the more expensive electric machines or where electric current is not available. The guide is geared 48 to 1 so that it is possible to move the torch with a sufficiently even motion to produce a clean cut.

Paulus "Cleancut" Guide for small-quantity shape cutting

The machine rides on the metal, keeping the torch always the same distance above it and producing a sharp top to the cut. The torch is the low-pressure injector type, and has a round-ring preheating flame.

PATENTS

APRIL 14, 1931

Metal-Working Machinery

Drop Hammer. Joseph F. Cox, Boston, Mass. Patent 1,800,339.

Machine for Embossing Curtain-Pole Rings. Charles W. Kirsch and Archie A. Allen, Sturgis, Mich., assigned to Kirsch Co. Patent 1,800,350.

Curtain - Pole - Embossing Machine. Charles W. Kirsch and Archie A. Allen, Sturgis, Mich., assigned to Kirsch Co. Patent 1,800,351.

Tube-Swaging Machine. Harry A. Higgins and Clifford B. Higgins, Detroit, Mich., assigned to Clifford B. Higgins. Patent 1,800,526.

Commutator Riveting Machine. Lora E. Poole, Anderson, Ind., assigned to Delco-Remy Corporation. Patent 1,800,567.

Dynamic Balancing Machine and Recording Amplimeter Therefor. Francis T. McDonough, Madison, Wis., assigned to Gisholt Machine Co. Patent 1,800,651.

Metal-Stamping Press. Arthur H. Schloz, Toledo, Ohio, assigned to The Toledo Machine & Tool Co. Patent 1,801,024.

Pipe Cutting Machine. Wylie B. Ewing, Wheeling, W. Va. Patent 1,801,038.

Welding Machine. Verni J. Chapman, Schenectady, N. Y., assigned to General Electric Co. Patent 1,801,140.

Tools and Attachments

Cutting Torch. George C. Quelch, Oakmont, Pa., assigned to Union Carbide & Carbon Research Laboratories. Patent 1,800,569.

Peening Tool. William C. Holden, Ossining, N. Y. Patent 1,801,005.

Method of and Means for Making Pronged Sheet-Metal Stiffeners. William H. Nickerson, Newton, Mass. Patent 1,801,018.

Casting Mold. James S. Thompson, New York, N. Y., assigned to The American Brake Shoe & Foundry Co. Patent 1,801,060.

Method and Apparatus for Coiling Wire. Cornelis A. H. Mulder, Eindhoven, Netherlands, assigned to General Electric Co. Patent 1,801,102.

Shearing-Machine Tool. Charles B. Gray, Millbourne, Pa. Patent 1,801,153.

Stone Holder for Honing Tools. Carl W. Floss, Detroit, Mich. Patent 1,800,213.

Tool Socket. George H. Remper, Cleveland Heights, Ohio, assigned to The Van Dorn Electric Tool Co. Patent 1,800,264.

Chuck. John Edward Graves, Baltimore County, Md., assigned to The Black & Decker Manufacturing Co. Patent 1,800,291.

Swing Grinder. Fredrich W. Marschke and William A. Marschke, Indianapolis, Ind., assigned to Marschke Manufacturing Co. Patent 1,800,307.

Safety Device for Punch Presses or the Like. Albert R. Homer, East Cleveland, Ohio, assigned to General Motors Corporation. Patent 1,800,528.

Apparatus for Removing Commutators from Armature Shafts. William E. Pabst, Anderson, Ind., assigned to Delco-Remy Corporation. Patent 1,800,566.

Processes

Metal-Casting Process and Apparatus. Martin E. Evans, Kankakee, Ill. Patent 1,800,249.

Pickling Apparatus. Frank L. Hummel, New York, N. Y., assigned to Copper Plate Sheet & Tube Co. Patent 1,800,533.

Metallurgical - Furnace Process. Thomas B. Stillman, South Orange, N. J., assigned to The Babcock & Wilcox Co. Patent 1,800,669.

Method of Casting Annealing Box Covers. Harry E. Sheldon, Pittsburgh, Pa. Patent 1,800,848.

Method of Coating Articles. Sumner Redway Mason, Wilmette, Ill., assigned to Western Electric Co. Patent 1,800,947.

Method of Casting Molten Metal. John G. Collins and William J. Reardon, Detroit, Mich., assigned to National Alloys Co. Patent 1,800,983.

Pickling Apparatus. Stephen L. Williams, Bridgeport, Ohio, assigned to Extruded Metal Products Co. Patent 1,801,063.

Furnaces

Heat-Treating Apparatus. Clarence Ross Gale Stewart and Clarence John Zern, La Grange, Ill., assigned to Western Electric Co. Patent 1,800,912.

Machine for Hardening the Bearing Points of Driving Shafts and the Like. Friedrich Klopp, Wald, Germany. Patent 1,801,090.

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

New York, April 23, 1931

VOL. 74 NO. 17

Watch Your Inventory

LAST week a manufacturer in the Middle West received a moderate order for equipment. Much to his surprise, word came back from his stockroom that the order could not be filled. Inventories had been allowed to drop until the minimum limit had been passed. Many minor orders, each so small that it was ignored, had made up a total volume of business quite unexpected. This manufacturer has awakened to his danger and has placed orders that will work back through the contributory channels of the industry, stimulating activity all along the line.

It will be well to check your inventories once more to make sure that one fairly respectable order will not put you in a hole. We were all so thoroughly chastened by the calamities that followed in the wake of the bloated inventories of the last depression that we have gone to the other extreme this time. If we are not careful we shall be in just as much trouble as we were in before, but for just the opposite reason.

U. S. Steel Makes an Employment Record

THERE are two interesting features in the 1930 report of the United States Steel Corporation, aside from tonnage and earnings. We refer to the number of men employed and the wage rate maintained. According to the statistics there was a reduction of less than two per cent in the working force, and the average day rate was but four cents less than in 1929.

Management of this kind shows clearly that huge corporations can do much to stabilize employment. Nothing can give them a better standing in the community. The facts presented also indicate the need for some method whereby smaller concerns can co-operate to secure corresponding security for their employees. It is possible that the methods used in handling accident compensation can be modified to suit the more difficult but equally important problem of steady employment.

The Three Chances

ONCE there lived, in a land hard by the sea, a maker of tools. His craft had been renowned even over the Great Water, but lately men whispered that he had grown too lazy to think. And there came a time when crops failed and prices fell, so that his orders were gone and his reserves were going. So he wailed, and his wailing aroused the water goddess, whom some men call Opportunity. Rebuking him, she said, "Three chances instead of one will I give you; now for heaven's sake, stop your wailing and take at least one." And she disappeared.

But the days flew by, and he saw no chances, for "chances" to him meant, as to most men, packages duly labeled and addressed to prevent their being mistaken for advertising circulars. Feeble knockings at his door went unnoticed, whispered advices went unheard and unheeded, until there came the Man with the Star, whom men call "Sheriff," who took away the plant and turned the tool maker out. So again he raised his wailing to the skies. A very wrathy goddess appeared, thundering, "Why weepest thou? You took none of the three chances I gave thee!"

Replied he in this wise: "But I saw none of them."

"Am I to label them?" asked the goddess. "The first was to design a line of tools for greater productivity or greater service."

"But that would have meant reorganization," he whimpered.

"Yes, instead of DIS-organization! The second chance was to consolidate your interests with some other builders, pool talents and reserves, strengthen your organization, cut down overhead, cut out unnecessary and unprofitable lines, and sell off your excess plant."

"But that would have submerged my individuality," he whimpered again.

"Yes, it might, instead of submerging you altogether. The third chance was to quit cold and sell out."

"But I couldn't think of giving up my business."

"So you gave it up anyway, without thinking and without recompense, didn't you? It is useless now to whimper, for no self-respecting goddess is going to furnish glasses for business astigmatism." And the goddess disappeared.

I—Long-Term Planning of Business Operations

D—*Plan for uniform production as far ahead as possible on the basis of sales requirements already determined.*

(1) Modernize and replace every existing production facility, including plants, factory and office equipment, and methods, where it is possible to effect cost reduction and greater production flexibility.

ALMOST since time began, a slogan has been part and parcel of any campaign, whether directed toward winning a war, paying off a loan, or putting across an Eat-More-Spinach Week. Characteristically, America has tried to use slogans as cure-alls, infallible panaceas for all our ills, be they social, economic, or industrial.

"Buy Now!" is a fatuous example. Bankers, business men, and industrialists shout it in chorus, forgetting that older, truer one beginning, "Do unto others—" Our slogan, since we must have one, might better be, "We are buying now!" If every sloganeer, adopting that one, became a purchaser, our economic difficulties would soon be forgotten.

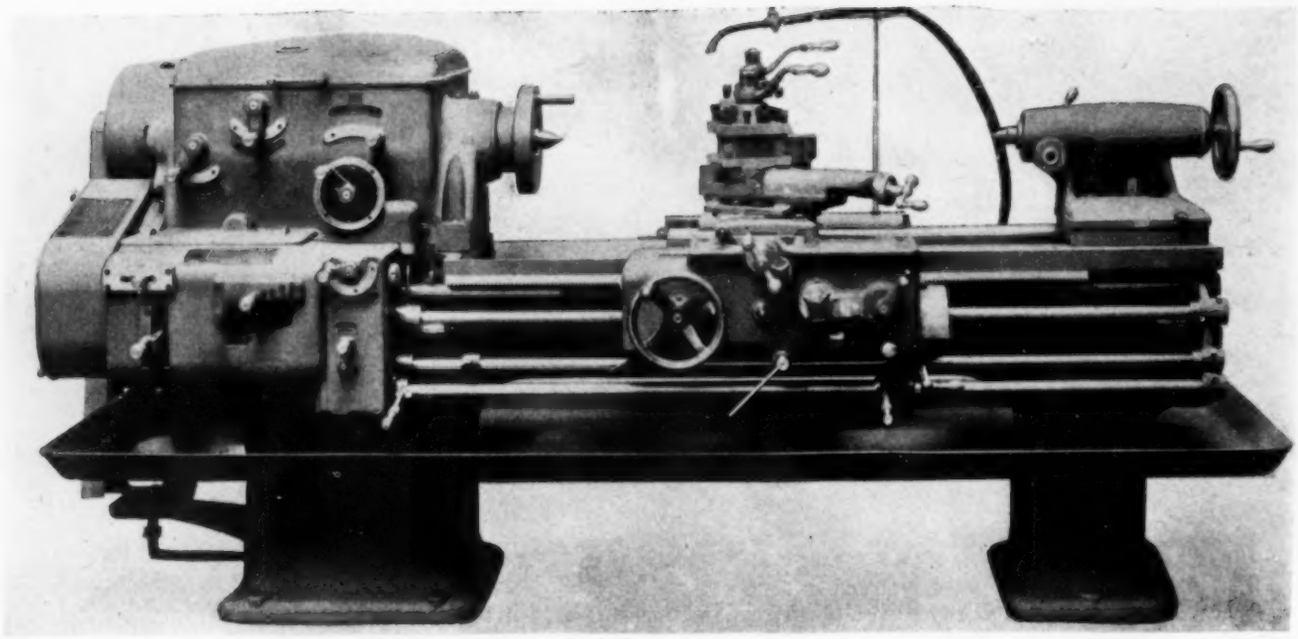
But a cycle of buying cannot start spontaneously. It must be started by a series of smaller buying movements, each giving profit to itself, thereby giving employment to men now out of work, and setting into motion the machinery to break the present vicious circle of delayed purchases.

A fundamental element of the return to normal would seem to be the replacement of out-of-date, obsolete, machinery with modern improved units. The need for such replacements is shown by *Amercian Machinist's* recent machine tool obsolescence survey, which showed that 48 per cent of all metal-working equipment now in use in this country is more than ten years old. Considering only the tremendous advances in engineering, design, and construction within the past five years, is it not more than evident that most machinery ten years old is hopelessly out of date? Regardless of age, a machine is out of date just as soon as another machine is developed that will do more or better work—that is fundamental.

For personal use, no intelligent purchaser would buy an automobile tire, a fountain pen, or a radio made ten years ago; he knows that he can get much better service from modern units. For plant use, it is all the more important that equipment be of the most-up-to-date type; not only service but profits are involved.

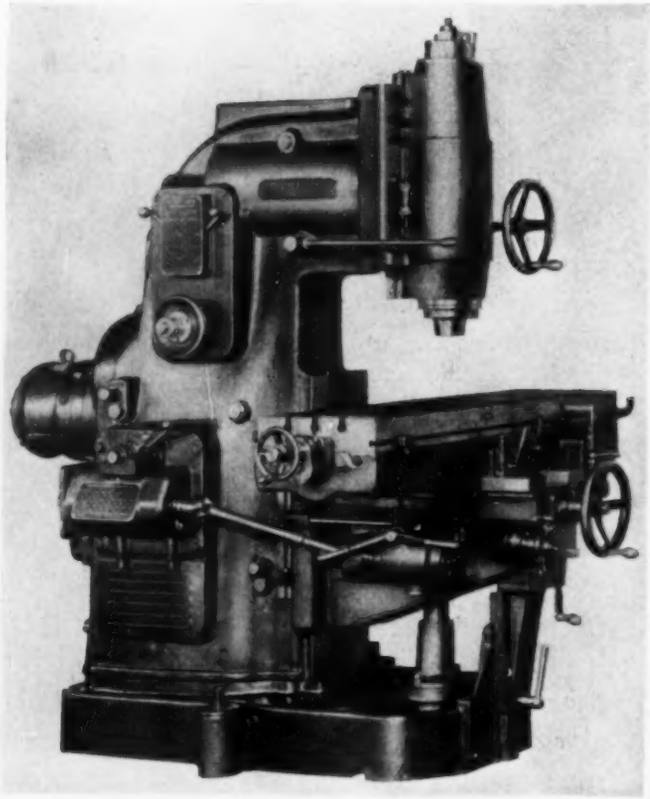
Another element is the greater cost entailed in using an old machine. Its user really pays for a new machine in high maintenance and spoilage; but neither he, nor his workers, nor his stockholders, get th benefit. Modern machinery raises wages, creates jobs, and enlarges opportunities. The time will come when no banker will provide credit lines to manufacturers hobbling along with obsolete equipment. Already, old equipment is a disastrous handicap in competition.

These and other phases of the question of obsolescence will be discussed by Carl A. Johnson, President of the National Machine Tool Builders' Association, in his talk as guest speaker during the "Westinghouse Salute to the Machinery Industry," over a National Broadcasting Company network of 25 stations, on Sunday, April 26, at 9.45 p.m., Eastern Daylight Saving Time. Even if you have other plans, take time out and "listen in." You'll find it well worth your while.

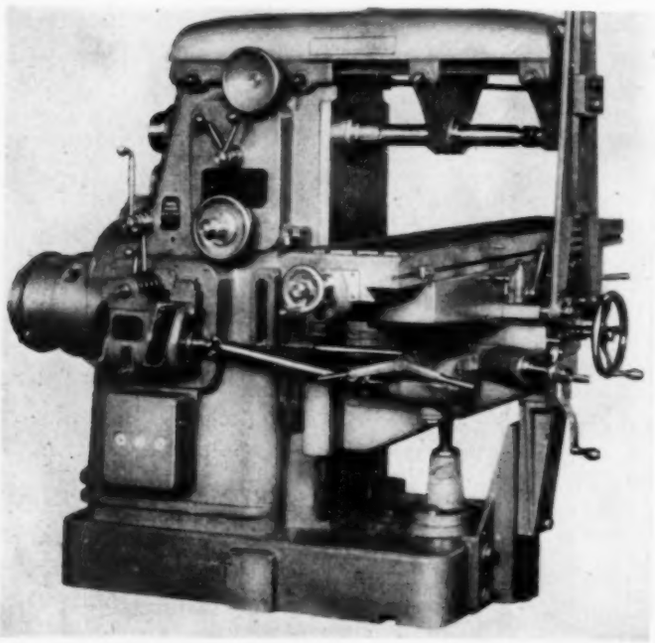


Machine Tools

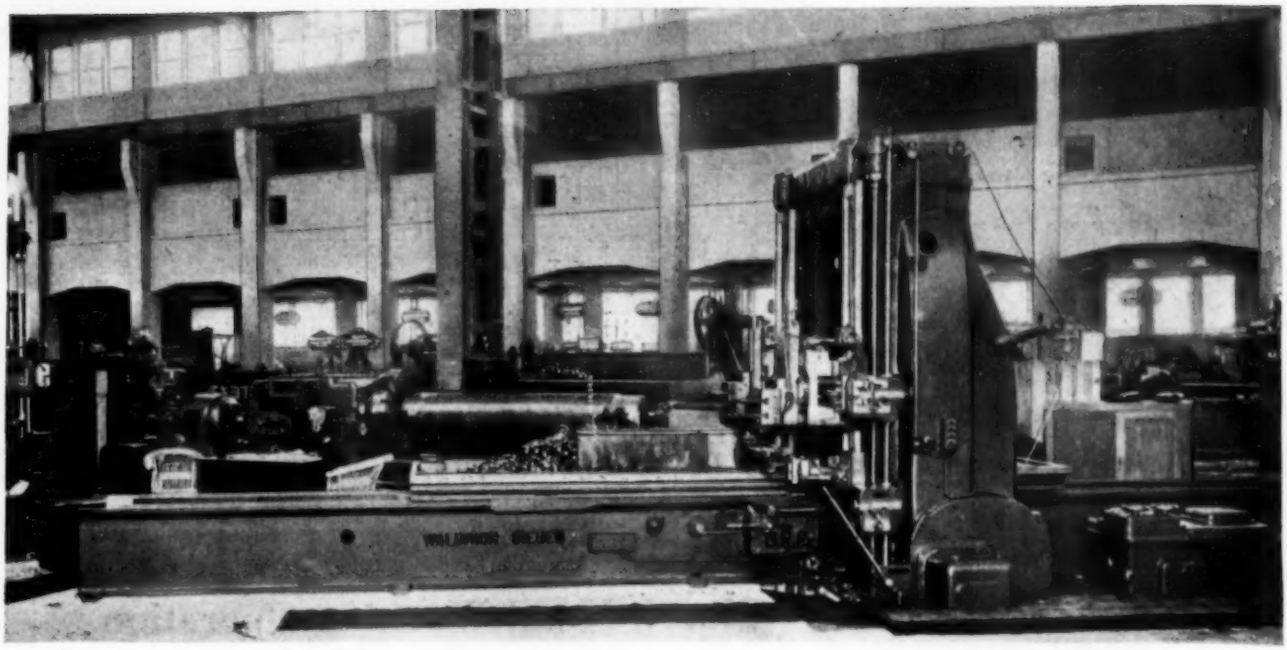
[Above] Well-protected slideways cast on the shears in a low position, permitting 10-in. swing over the bed without a break in the ways, distinguish this Schaererwerke high-speed lathe. The carriage and apron are cast integrally with double-bearings for the gears. A precision automatic stop and either single-pulley or flange-motor drive are incorporated. The main shaft rotates in either direction through a multiple-disk clutch; the stepped gear is positioned independently of the main shaft, and the feed box permits cutting of metric or module threads without gear change



Vertical milling machine with flange-mounted motor and longitudinal rapid traverse of the table, shown by Biernatzki & Cie. An oil pump lubricates all bearings; special control mechanisms for feed, rapid traverse, and change of direction of rotation may be incorporated

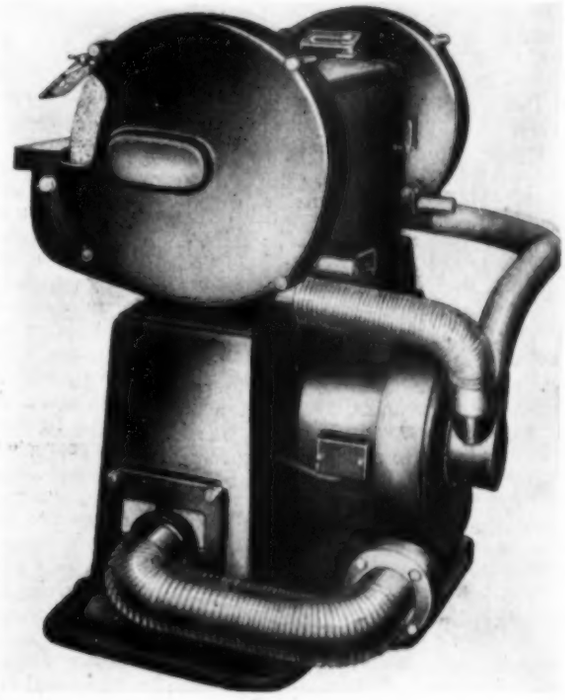


Horizontal console milling machine with flange-mounted motor, shown by Biernatzki & Cie. An oil-circulating system and longitudinal rapid-traverse of the table are incorporated, and some handwheels are of the solid type



ls at the Leipzig Fair—III

Last of a series of three articles



[Above] A heavy-duty dry grinder with exhaust and dust collector in the base, shown by Wilhelm Simon. Grinding wheels up to 20 in. in diameter may be accommodated, the cast steel covers automatically following all adjustments of the grinding rest. An automatic electric locking device cuts out the motor current in case the wheel should break or the work should stick. When cut out, an automatic reverse current brake brings the machine to a quick stop

Turntable type high-speed milling machine arranged for unit drive by a vertical flange-mounted motor, shown by Miller & Montag. It operates at 2,000 r.p.m., machining light-metal parts at cutting speeds of more than 3,000 f.p.m. The same company showed a die-sinking type small vertical miller, with spindle speeds up to 8,000 r.p.m., and a suction-type chip removal system

[Top] Planer with hydraulic drive and pushbutton controls, shown by Waldrich Siegen. Other machines worthy of note included special small shapers for machining small parts, having a stroke of less than 18 in. and capable of handling parts 8x9½ in. in cross-section, shown by Gartner & Haas G.m.b.H. Several precision grinders had hydraulic table feeds

NEWS OF THE WEEK

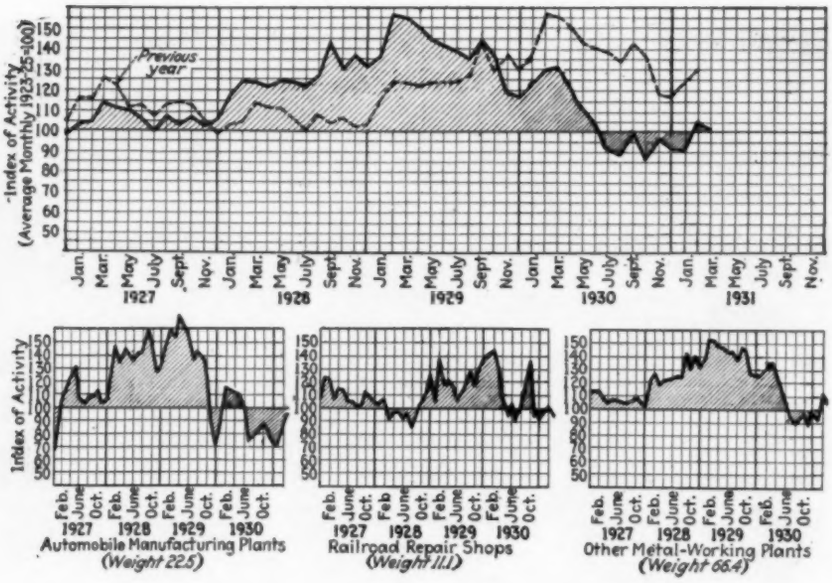
Gray Iron Committees To Meet in Chicago

Several Committees of the Gray Iron Institute, as well as the Board of Directors, are meeing at the Stevens Hotel, Chicago, during the A.F.A. Convention the first week in May. Meetings include the Cost, Membership, and Technical Committees, on May 6, and the Finance & Budget Committee and Board of Directors on May 7. The Gray Iron Institute Luncheon will be held at the Stevens Hotel, Chicago, on Wednesday noon, May 6. Executives of non-member companies may attend. The Chicago District Chapter of the Gray Iron Institute will be host at the Luncheon.

UNITED STATES' foreign trade, while remaining below normal levels, showed a marked increase over February of $49,000,000, with a total of $448,000,000. Much of the increase was attributed to seasonal improvement. March exports were valued at $237,000,000, an increase of about $13,000,000 over the preceding month. Imports were $211,000,000, a gain over February of about $36,000,000. Foreign trade was below that of March a year ago, however, by about $132,000,000 on exports and $89,000,000 on imports. Power-driven metal-working machinery exports declined from $3,678,661 in February to $2,766,930 in March. Other metal-working machinery exports declined from $307,293 to $249,510.

SIMPLIFIED Practice Recommendation R100-29 on Welded Chain has been reaffirmed by the Standing Committee without change for the ensuing year.

THE National Association of Purchasing Agents, Inc., has instituted a contest offering three cash awards totaling $1,500 for a practical method for measuring the efficiency and proving the value of the purchasing department. The competition is being conducted under the rules of the National Association of Cost Accountants and is open to members of both organizations.



March Metal-Working Operations Show Slight Decline

A SLIGHT slowing up in activity from a final figure of 105.7 in February to 100.3 in March is indicated by reports on the consumption of electrical energy for power purposes. This compares with the final figure of 90.1 in January. This slight decline continues a period of mixed trends. For example, last September, operations showed a sharp upturn from those of August, but the October decline more than equalled the previous advance. November again showed a sharp advance, but the trend thereafter was slightly lower, until last month when the upturn was again sharply upward.

All figures given in these summaries are corrected for 26 working days. The automobile shop index, given as 72.9 for January and 88.9 for February, increased to 94.1 in March. The railroad repair shop index for January of 95.6 and 102.1 in February, decreased to 94.3 in March. This compares with 91.8 in December and 97.8 in November, 1930. Ferrous and non-ferrous metal-working plants outside the two groups aforementioned have a March index of 103.5, as compared with 112.3 in February, 92.9 in January, 97.8 in December, and 99.4 in November, 1930.

When the figures are adjusted seasonally, however, slight changes occur. The railroad repair shop index drops from 94.3 to 90.3, while that for metal-working drops from 103.5 to 95.3 and that for automobiles drops from 94.1 to 88.2. This gives a seasonally adjusted figure for the group of 92.9, as compared with 95.9 in February, 87.7 in January, and 100.5 in December. The adjusted figures for February were: Railroad shops, 90; metal-working shops, 100.7; automobile shops, 85.3; while those for January were: Railroad shops, 90.5; automobile shops, 84.5; metal-working shops, 87.9.

The general impression gained by the figures shows a decided rise since the low values of winter, bringing operations back somewhere around the level of June, 1930, the recoveries having come mainly in February and continuing in March at about the February level. Railroad shops for February and March average about the same as during the winter. Metal-working has picked up from October and November lows and averages 17 per cent higher for February and March, also considerably higher than in December and January. Automobile plants are clearly higher than at any time since June, but the index remains lower than for any March in the series of records, which goes back to 1923. There is a strong possibility that the indications of a recession in March are untrue, since electric meters for the short February are probably read earlier than they should be. This "steals" some operations from March and puts them into February.

Taylor Spring Meeting On "Planning"

"Planning" will be the general theme of the Taylor Society's Spring Meeting, to be held in Philadelphia from April 30 to May 1. The program will start with an afternoon talk on "Planning Sales," by Stuart D. Cowan. The evening session will be on "Planning on the Scale of an Industry," by Thomas L. Chadbourne. Friday morning's program will begin with a talk on "Planning Production," by Ralph E. Flanders, Manager of the Jones & Lamson Machine Co. The afternoon will be taken up by simultaneous group sessions on Production Routing, Planning Labor Relations, The Relation of Cost Accounting to Budget Making, and Planning Work in the Office.

Hobbs Tells Metal Traders Depression Trough Was in December

SPEAKING before the 33rd Annual Meeting of the National Metal Trades Association at Cincinnati, Franklyn Hobbs, Director of Research, Central Trust Co., Chicago, stated flatly that the trough of the depression was passed on Dec. 19, 1930. The meeting was held at the Hotel Sinton on April 15 and 16. 750 attended the banquet.

Mr. Hobbs' subject was "The Machine and Its Consequences," and he made out a very good case for the machine. He pointed out that America has the highest percentage of workers in every social group, the highest percentage of workers in the millionaire class, and the lowest percentage of beggars in the lowest class, of any nation. Nearly half of our population is gainfully employed, and this does not include minors on farms. The average American, he said, asks only a chance to work at something better than a living wage. During the last 30 years enough machinery has been installed here to replace as many workers as there are people on the North American continent. If machinery actually creates unemployment how is it then that anybody is working at all?

As a member of one of Coxey's armies Mr. Hobbs claimed to be in a position to maintain that the troubles of this depression are heaven compared to those of 1893-96. He dates the Machine Age from the end of 1899 and insists that it is only since then that the machine has been effective in raising wages and standards of living. In raising his own standards the worker has pushed up the standards of the rest of us. Mr. Hobbs believes that the millions of workers now laid off will be totally insufficient to do the work of making the new products that research will soon make commercial; that more and better machinery must be designed, built, and bought to supplement their efforts.

Pres. J. G. Benedict, of the Landis Machine Co., was re-elected by unanimous vote, as were Jacob D. Cox, Jr., Cleveland Twist Drill Co., first vice-president, and J. W. O'Leary, Arthur O'Leary & Son Co., treasurer. Alexander Sellers, Wm. Sellers & Co., was elected second vice-president.

In his presidential address Mr. Benedict pointed out that the high point of employment in the metal trades is in May, the low point in December. He commented on the relative absence of labor difficulties in the last year and a half, observing that there was but one strike during 1930 in the plant of a member of the N.M.T.A., while there were 53 in outside plants. Whereas there were 300,000 union machinists in 1920, there are now but 60,000. The widely heralded effort to unionize the automobile industry failed. In closing, Mr. Benedict said, "There is a danger that younger executives coming into places of industrial responsibility, and without a background that furnishes a knowledge of the place and function of our Association, will fail to recognize that the foundations of industry are laid upon certain fundamental principles in the establishment and preservation of which, the Association has taken and does take an important part. It behooves us, who know the rapidity with which industry develops and changes, to acquaint the oncoming generation of industrial leaders with the dangerous shoals along industry's coast, and to indicate the places of anchorage which provide a refuge when the going gets a little rough."

Harold S. Falk, the Falk Corporation, reporting for the Educational Committee, urged the establishment of apprentice and training programs now. He said that it was most unfortunate that 30 member companies had thought it necessary to abandon such programs.

In the course of a paper on foreman training, C. W. Pendock, the LeRoi Co., depicted the foreman as the clutch between management and men. He must be so trained that he can interpret the policies of the company to the men working under him. If a foreman chosen from the ranks fails because he has had inadequate training, the fault lies with management. He remarked that no apprentice program could succeed if the foremen were antagonistic. It is also vitally necessary that a foreman be cost conscious.

Philip M. Morgan, Morgan Construction Co., recommended the appointment in every company of a safety man who would keep informed of general safety developments and pass on the important ones through the foremen. H. W. DeBruin, The Jeffrey Manufacturing Co., set up as a task for the industry the training of those boys who, often through no fault of their own, do not have all the schooling to which they are entitled. Fulfillment of this responsibility will help industry, which will be hard put to get enough all-round mechanics when activity quickens, and will help the community, which can never have too many good citizens.

Mr. O'Leary, in the course of a talk on "Minding Your Own Business," observed that failure to do just that, and indulging in speculation had brought on the crash of 1929, and that failure to attend strictly to business and the indulging in gossip that increases fear, had forced liquidity on the banks and was postponing restoration of confidence.

Ernest F. DuBrul, General Manager, National Machine Tool Builders' Association, quoted the *American Machinist* Survey of Equipment in Metal-Working Plants to prove the need for replacement and announced the Westinghouse Salute broadcast to be delivered by C. A. Johnson, president of the N.M.T.B.A., on April 26. He pointed out how this tied in with the McGraw-Hill platform for business and told of the plans of the Associated Business Papers to extend the movement to all types of equipment. He closed with the slogan, "Old machinery in the shop shows obsolescence at the top."

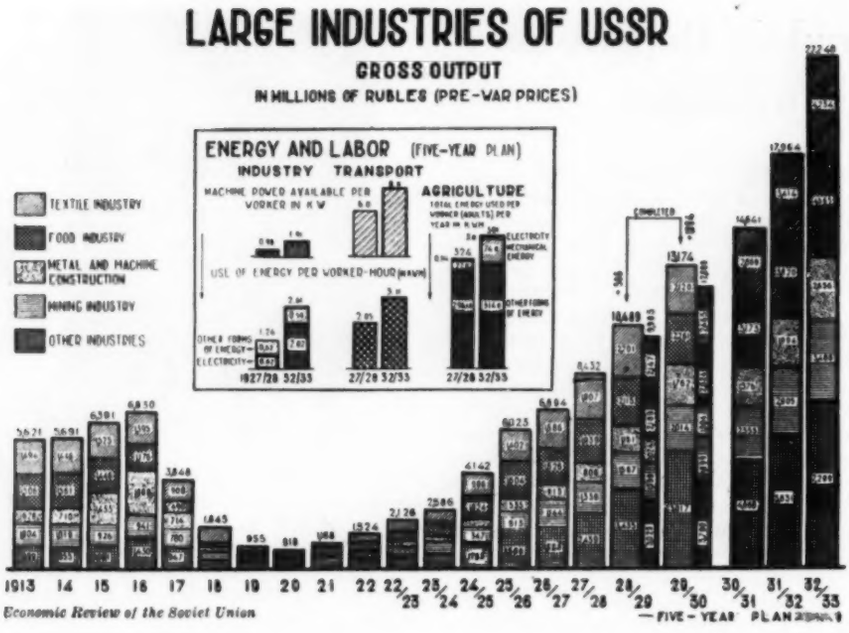
J. G. BENEDICT

President Herman Schneider, of the University of Cincinnati, explained the structure and behavior of atoms, molecules, and electro-magnetic waves, illustrating his points by explaining how Vitamin D is formed by bombardment of atoms with ultra-violet rays. He concurred with those who believe that the machine makes employment instead of destroying it, and warned his hearers that research will influence their business in the near future more than any other one thing. "In 25 years," he said, "many of our signposts have become weathervanes."

Hon. A. O. Stanley, formerly governor and senator from Kentucky, addressed the audience on "Individual Initiative in Business." Hon. Chas. A. Easton, U. S. congressman from New Jersey, spoke on the "World Background of American Business." He said that in the years to come we are going to be either all Russian or all American, and that in the meantime each system is affecting the other. We have fought for freedom of religion, of politics, of thought, and now for industrial freedom. No man or group of men has ever amounted to anything that has had everything done for it. Our spirit of fear has come from too much luxury and softness.

In the course of a committee report, Dr. P. O. Geier recommended that meetings of the association be held monthly instead of annually in view of the serious problems facing us. The suggestion was favorably received. Chas. Oesterlein presented the three winners in an apprentice drafting contest, and President Benedict gave each a set of drafting instruments.

THE Insurance Division of the American Management Association will hold a conference at the Palmer House, Chicago, Ill., April 27 to 29.


LARGE INDUSTRIES OF USSR
GROSS OUTPUT
IN MILLIONS OF RUBLES (PRE-WAR PRICES)
ENERGY AND LABOR (FIVE-YEAR PLAN)
INDUSTRY TRANSPORT
AGRICULTURE
TEXTILE INDUSTRY
FOOD INDUSTRY
METAL AND MACHINE CONSTRUCTION
MINING INDUSTRY
OTHER INDUSTRIES
1913 14 15 16 17 18 19 20 21 22 22/23 23/24 24/25 25/26 26/27 27/28 28/29 29/30 30/31 31/32 32/33
— FIVE-YEAR PLAN
Economic Review of the Soviet Union

Gross output of industry in pre-war Russia and the Soviet Union, including establishments with power and more than 15 workers, or no power and more than 30 workers

U. S. Steel Obtains Krupp Licenses

An arrangement has been concluded by the United States Steel Corporation with Fried. D. Krupp A.G., of Germany, whereby subsidiary companies of the U. S. Steel Corporation are licensed by Krupp under various patents for rust-resisting, heat-resisting, and other alloy steels and for the heat-treatment thereof. This arrangement, which includes the collaboration of Krupp with respect to technical matters in connection with corrosion and heat-resisting steels, etc., will apply to products of the Illinois Steel Co., Carnegie Steel Co., American Steel & Wire Co., American Sheet & Tin Plate Co., National Tube Co., and the Lorain Steel Co. Major products manufactured by the companies in these steels will include plates, shapes and bars, strip wire products, rope, sheets, tubes, and castings.

THE National Association of Cost Accountants will hold its Twelfth International Cost Conference at the William Penn Hotel, Pittsburgh, Pa., June 15 to 18. The technical sessions will examine the past methods of an actual business, results of which will be reflected in reports presented at the opening session. The remainder of the sessions will develop modern ideas of management for the salvation of the particular business, but will also make it a case study.

Soviet Purchases Here Decline 45 Per Cent

PURCHASES of American products by the Amtorg Trading Corporation for shipment to the Soviet Union amounted to $33,385,000 for the six months ending March 31, 1931, as compared with $60,441,000 for the corresponding period of the preceding fiscal year, a decline of 44.8 per cent. This sharp drop, contrasting with a steady increase during the preceding five years, is ascribed by Peter A. Bogdanov, Chairman of the Board of Directors of the Amtorg Trading Corporation, who released the figures, to the increasingly unfavorable conditions prevailing here with regard to trade relations with the Soviet Union. Reductions in purchases were recorded for all major groups of commodities with the exception of automotive and power equipment, for which general contracts covering a period of years are in force with several firms.

Amtorg purchases for the quarter, October-December, 1930, amounted to $14,423,000, and for January-March, 1931, to $18,962,000. Imports of raw materials and semi-manufacturers for the period October 1, 1929, to March 31, 1930, were $5,297,000, as compared with $1,958,000 the same period of last year, a decline of 63 per cent. Similar figures for industrial and electrical equipment are $24,644,000 and $16,336,000, a decline of 33.7 per cent. Automotive equipment import figures under the same conditions were $7,284,000 and $7,087,000, a decline of 2.7 per cent. Agricultural equipment declined from $23,134,000 to $7,907,000, a decline of 65.8 per cent, while miscellaneous equipment increased from $82,000 to $97,000, an increase of 18.3 per cent.

In contrast, Soviet-German relations in the middle of 1930 underwent a favorable change. Also a delegation of the most important representatives of German industry recently visited Moscow. Great Britain is also interested in developing better economic relations. During the first year of normal relations, 1929-1930, Soviet purchasing in England grew to $75,000,000, in comparison with $48,000,000 for the previous year. Relations with Italy during the past two years, according to Soviet reports, have been developing along normal lines, and in general favorably. Relations with Japan are also reported as being favorable.

Small Planes and Single Engines Feature Detroit Air Show

OUTSTANDING at the Detroit Air Show was the first public display of the Autogiro as a plane in production, competing with more conventional types. There was also an unusual number of small "flivver" planes, some of them little more than high-powered gliders. Stout's small air car is of novel design, having a skeleton fuselage behind the pilot's compartment and a pusher engine. Small engines also were prominent, nearly all of them being of the air-cooled, cylinder-in-line type, usually inverted. One two-cycle radial was exhibited.

In contrast with the small engines was the new Ford freight or express plane in which the three-motor idea has given way to a single Hispano-Suisa engine of larger power than any radial in this country. Fokker exhibited nothing but single-motored planes, there being apparently a trend away from multi-engined planes where single engines of sufficient power can be secured.

Amphibians are receiving more attention, and these in nearly every case had two motors. Various methods of handling the wheels were in evidence.

A careful study of the planes and engines indicates that a few of the builders are getting down to a business basis much as did the automobile builders ten or fifteen years ago. While engine cost largely determines the price of a plane, one difficulty has been the constant changes in design, so that production costs were necessarily high. A few builders are approaching sufficient standardization to secure reasonable shop costs and are selling planes at prices that should encourage buying as well as discourage hand-to-mouth builders. Air lines equipped with these ships are beginning to operate on a business basis and the industry shows signs of emerging from its period of depression.

PERSONALS

Sir Arthur Balfour, head of the British steel manufacturing firm of Arthur Balfour & Co., Ltd., Sheffield, England, is visiting in this country.

Joseph H. Barber, Assistant to the President of the Walworth Co., spoke at the meeting of The Industrial Marketing Executives of New York on April 14. His subject was "Industrial Marketing Research."

J. J. Baum, formerly with the Ohio Steel Foundry Co., Springfield, has been appointed head of the development engineering department, Steel Founders' Society of America, New York.

W. D. Flannery, until recently vice-president and director of the K-G Welding & Cutting Co., New York, has been named manager of the Harris Calorific Sales Co., New York, affiliated with the Harris Calorific Co., Cleveland.

Albert E. Grover, Cost Consultant of the National Machine Tool Builders' Association, was the guest speaker at the April dinner meeting of the Milwaukee chapter, National Association of Cost Accountants.

Edwin T. Hall has been appointed manager of the Boston office, at 45 Milk St., of the Sullivan Machinery Co., Chicago. He succeeds the late George H. Richey.

Strickland Kneass has resigned as chief engineer of the A. M. Byers Co., Pittsburgh, to become affiliated with the Leif Lee Co., Pittsburgh, manufacturer of heating and ventilating equipment.

J. M. Mercer, Tulsa, Okla., has been appointed midcontinent sales representative of the Wire Fabric Division, Wickwire Spencer Sales Corporation, New York City.

Bertram D. Quarrie, for the past three years president of the Oliver Iron & Steel Corporation, Pittsburgh, has resigned.

Adolph Rider, Jr., in charge of the Atlanta (Ga.) offices of the Lukens Steel Co., Coatesville, Pa., has been placed in charge of the new sales offices in New Orleans at 304 Pan American Bldg.

E. N. Stevens, formerly assistant sales manager, Bastian-Blessing Co., Chicago, has been appointed assistant sales manager, Harris Calorific Sales Co., New York. He will have his headquarters in Cleveland.

Charles A. Williams has been elected president of the Standard Safety Razor Co., East Norwalk, Conn., to succeed the late D. M. Mason.

T. P. Wright, Chief Engineer of the Airplane Division, Curtis Aeroplane & Motor Corporation, has been awarded the Wright Brothers Medal presented annually to the "author of the best paper on aerodynamics or structural theory or research, or airplane design or construction, which shall have been presented at a meeting of the S.A.E." His paper deals with "Development of a Safe Airplane—The Curtiss Tanager."

Theodore Marvin has been appointed advertising manager of the Hercules Powder Co., Wilmington, Del., to succeed Nelson S. Greensfelder, who died April 5.

OBITUARIES

W. R. Addicks, 70, Senior Vice-president of the Consolidated Gas Co., New York City, director of a dozen associated utilities, and in the past chief engineer of a number of utility companies and utility equipment manufacturing companies, died April 14 on his 70th birthday.

Walter T. Brown, 61, who previous to his retirement was affiliated with the Columbus (Ohio) Mill & Mine Supply Co., died April 10.

Fred L. Bryant, 75, formerly president of the Chicago (Ill.) Metal Works, died recently there.

Raymond Burton, 41, formerly vice-president and manager of the Standard Steel Co., North Kansas City, Mo., died March 28 at Albuquerque, N. M.

Leonard Cahoon, 49, Western Representative for the Foster Wheeler Corporation, New York, died in Salt Lake City, April 8. Death was due to cancer.

Henry Murray Cameron, 53, Chief Naval Architect and Chief Estimator of Canadian Vickers, Ltd., Montreal, died at his home in Montreal, on April 10. Mr. Cameron was former manager of Canadian Vickers, Ltd., in Montreal, as well as former manager of the Vickers plant in Lancashire, England.

Daniel H. Deyoe, 55, of the industrial engineering department of the General Electric Co., a director and member of the American Welding Society and a figure for many years identified in electric arc-welding activities, died in Schenectady, April 11.

Frank A. Estep, 82, former president of the R. D. Nuttall Co., Pittsburgh, died April 12 at St. Petersburg, Fla.

John W. Exler, 72, formerly president of the James Lappan Manufacturing Co., Pittsburgh, Pa., manufacturing boilers and tanks, died recently.

James Spence, 60, head of the James Spence Iron Foundry, Jersey City, N. J., died recently.

J. B. Terbell, 68, Chairman of the Board of Directors of the American Brake Shoe & Foundry Co., with which he had been associated for the last thirty years, died April 15, in New York City, after an illness of six months.

FORTHCOMING MEETINGS

TAYLOR SOCIETY—Spring Meeting, Benjamin Franklin Hotel, Philadelphia, Pa., April 30-May 1. P. E. Henderson, Associate Secretary, 29 W. 39th St., New York, N. Y.

AMERICAN FOUNDRYMEN'S ASSOCIATION—Annual convention and exhibition, Stevens Hotel, Chicago, May 4-8, 1931, C. E. Hoyt, 222 West Adams St., Chicago, secretary.

SOCIETY OF AUTOMOTIVE ENGINEERS—Annual Spring Production Meeting, May 7-8 at Hotel Schroeder, Milwaukee. J. A. C. Warner, 29 West 39th St., New York, N. Y., Secretary.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION—Annual Spring Meeting, Hotel Statler, Buffalo, May 7-9, 1931. T. W. Owen, 3608 Euclid Ave., Cleveland, secretary.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Calvin W. Rice, executive secretary, 29 West 39th St., New York. The following meetings are scheduled:

National Aeronautic Meeting, Baltimore, Md., May 12-14, 1931.

National Applied Mechanics Meeting, Purdue University, Lafayette, Ind., June 15-16.

AMERICAN STEEL & HEAVY HARDWARE ASSOCIATION — Twenty-second Annual Convention, May 18-20, William Penn Hotel, Pittsburgh. B. R. Sackett, 505 Arch St., Philadelphia, secretary.

NATIONAL FOREIGN TRADE COUNCIL—Annual Convention, May 27-29, at the Hotel Commodore, New York City. O. K. Davis, secretary, 1 Hanover Square, New York, N. Y.

AMERICAN MANAGEMENT ASSOCIATION—Annual Conference, Production Division, Rochester, N. Y., June 1-2. Headquarters, 20 Vesey St., N. Y. C.

NATIONAL ASSOCIATION OF PURCHASING AGENTS—Annual Convention and Informashow, Royal York Hotel, Toronto, Canada, June 8-11. G. A. Renard, 11 Park Place, New York.

NATIONAL ASSOCIATION OF FOREMEN—Eighth Annual Convention, Biltmore Hotel, Dayton, Ohio, June 12-13. Detailed information from the National Association of Foremen, Refiners Bldg., Dayton, Ohio.

SOCIETY OF AUTOMOTIVE ENGINEERS—Summer meeting, June 14-19, White Sulphur Springs, Va. Green Brier Hotel. J. A. C. Warner, secretary, 29 West 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS—Annual Meeting, Steveens Hotel, Chicago, June 22-26. C. L. Warwick, 1315 Spruce St., Philadelphia.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Annual Summer Convention, June 22-26, Asheville, N. C. F. L. Hutchinson, 33 West 39th St., New York, N. Y., secretary.

NATIONAL METAL CONGRESS AND EXPOSITION — Exposition on Commonwealth Pier, and Congress sessions at Hotel Statler, Boston, Mass., week of Sept. 21. Information from W. H. Eisenman, Secretary A.S.S.T., 7016 Euclid Ave., Cleveland, Ohio.

NATIONAL SAFETY COUNCIL—20th Annual Safety Congress, Chicago, Oct. 12-16. Details from headquarters, Civic Opera Bldg., 20 North Wacker Drive, Chicago.

THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine tool business

NEW YORK

Watchful waiting remains the watchword in machine sales. April will probably end at about the same level as March, for in some cases it is off slightly, in others up a little. One or two dealers had a better week, several had a slower one. Many sales are small tools to small buyers, and some second-hand tools are going also. Amtorg is still buying. Inquiries were fair, those for export including one for 15 tools to go to China. These were largely general machinery of the cheapest varieties, but included three millers, a slotter, and a "high-speed" planer. One dealer sold a lathe to the city. Prospects still must be dynamited to gain sales. Westinghouse has received a $1,250,000 order for turbines.

NEW ENGLAND

New England trade is rather skeptical concerning a substantial revival of machine tool transactions during this second quarter. Business among dealers and builders continues decidedly spotty.

April thus far bears out this forecast. No steady volume of orders has resulted from inquiry promise extending over the first quarter. Some houses report improvement, but the summary does not tend to general improvement in April. Orders run mostly to single tools, with one large order for lathes noted. Amtorg is interested in heavy-duty automatic machinery to equip an automobile plant. A good railroad inquiry and good Government lists offer greatest promise.

CINCINNATI

One machine tool manufacturer had sufficient additional business during the past week to require a considerable increase in manufacturing activity. Two others made a slight gain in sales, but with the majority there was no change. Local selling agents noted no change in demand, but had a slight increase in number of inquiries. One manufacturer received from China an order for three lathes and also made some sales to shipyards. Most orders were for single tools, from various classes of users. Business was well scattered and requirements were well diversified. A few manufacturers reported a slight increase in the number of inquiries, requirements in most cases being single tools of efficiency types for replacement purposes. An inquiry from the U. S. engineer at Vicksburg, Miss., calls for five tools to be used on a dredge. These include a lathe, shaper, drill, tool grinder, and pipe machine. Bids will be opened April 28. Standard Electrical Tool recently sold the Navy Department 6 high-speed snagging grinders.

MILWAUKEE

Although sales of machinery and machine tools so far this month indicate that the March volume may not be maintained, the industry reports fair sales, and the general tone continues to improve. March was a high spot; even if its volume is not maintained, scattered buying is producing satisfactory volume. This indicates continuance of the gradual improvement of the past few months and is taken to indicate that by fall real business will be forthcoming. Orders are coming in from the principal manufacturing centers, as well as some export. One manufacturer has received orders for $40,000 worth of bottle-washing machines and beer pasteurizers from the Pacific Coast. Eastern electrical manufacturing firms have placed orders here as have shipyards and the Navy. While there is more activity in the Detroit automotive field, few orders for new tools have been received here. Much of the business placed in Milwaukee is for standard tools with special attachments.

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Postponement and indecision, characteristic of general business, are also true of machinery and machine tool markets. Occasional large sales alternate with periods of inactivity, and inquiries seem similarly afflicted. Sales are almost all achieved after weeks of work, and are usually essential replacements or high-production units. The general tone is better, but April is not expected to equal March's average.

NEW YORK reports little new, including several sales for export and a 15-tool inquiry from China. New England trade is skeptical, orders running principally to single tools, although one large order for lathes and inquiries from Amtorg, a railroad, and the government offer some promise. Cincinnati has three manufacturers stepping up operations, but little change in selling agents' demand, except for increased inquiries, and sales of six grinders to the Navy and three lathes to China. Milwaukee reports satisfactory buying volume, although improvement is not seriously expected until fall. Cleveland's flurry of orders seems to have petered out. Some plant expansions and a list or two are expected there.

DETROIT has plenty of optimism but few machine tool orders, although the model changes of the early fall are expected to bring business late in the summer. Jobbing shops there are quiet. Chicago reports no appreciable changes. Inquiries are piling up, but there appears to be small likelihood of closings immediately, even on the railroad and municipal lines, although the latter is expected to be speeded up under the influence of the new administration. Southern District continues quiet to fair, with government buying and prospects of other sales helping morale.

CLEVELAND

The flurry of machine tool orders which were very much in evidence the first week in April has subsided, and the industry is back again in its nonchalant lethargic way. Sales were limited to small items and single tools. Inquiries too, have declined. The feature at the present time is a list issued by the Smith Engineering Co. This company is inquiring for production tools to manufacture an airplane part. The list has been widely distributed and stiff competition is expected.

Architects who specialize in industrial construction report an increase in contemplated plant expansions and new factory buildings. Negotiations are now underway for the merging of an address plate and a printing machine company. If the deal is consummated, the new company will erect one of the largest plants in this city. Re-tooling is also contemplated.

DETROIT

The automobile industry continues to advance in the second quarter and prospects for a still greater gain are being manifested. Optimism is increasing in nearly all lines, and while sales of machinery and machine tools are not advancing very rapidly, most dealers are encouraged by the favorable indications. Motor car sales constitute by far the most promising news. Manufacturers are cautious but definitely optimistic. Their caution is exemplified in their reluctance to release actual orders for machinery, and their optimism is shown in their continued inquiries.

Most buying is still for replacements. Plants are still far from capacity production and executives seem determined to make the old machinery serve all needs until production is pushed still further ahead. Contract jobbing shops are buying almost nothing. Most of them are idle and expect to remain so until late in the quarter.

When plans are made for model changes late in the summer it is likely the machinery and machine tool business will experience a radical revival.

CHICAGO

No appreciable change in the machine tool situation can be discerned. Manufacturers' representatives and distributors are practically unanimous in declaring that the outlook for the near future is not greatly promising. Inquiries have been accumulating, some of them for many months, but closing, according to those asking quotations on new equipment, cannot be decided on until improved industrial conditions warrant the outlay involved. With the exception of railroads, most of whose present needs have been made known and are now in the hands of the trade, inquiries mainly involve equipment for replacement purposes, no important plant expansions being announced. The Chicago Board of Education, whose inquiries for prices on technical and high-school shop equipment contemplate the purchase of machine tools whose aggregate value runs into big figures, has done little or no closing since the lists were mailed. It is intimated, however, that under the stimulation of the new municipal administration, activities in this direction will be started before long.

SOUTHERN DISTRICT

While there was a slight let-up in volume of machinery and machine tool orders reported the past fortnight, business, it was generally conceded, was fair and showed no evidence of reacting from better prevailing conditions of the past few months. Orders continued scattered both as to industries buying and geographic locations. Small tools constituted the bulk of orders, with hand-to-mouth inquiry for shop equipment. Government buying throughout the district has been good, and several orders of this type, originating out of the Naval Station at Pensacola (Florida), have been consumated.

Some successful drilling is going on in the Longview (Texas) oil fields, and the trade is looking forward to brisk inquiry from the district just as soon as things get under way. With the exception of this particular field, however, the oil industry of Louisiana and Texas has been quiet. Industrial buying of all Southern States has been slow and uncertain. Relatively little buying has been done by the railroads, and it has been some months since lists of any consequence have been on the market. Used machinery and machine tool prices have been steady and there has been little or no increase in stocks on hand.

BUSINESS • BAROMETER

The outlook is confusing, but the abundance of money and credit should sustain trade

THEODORE H. PRICE
Editor, Commerce and Finance, New York

ALFONSO'S flight from the Spanish throne was featured as last week's most important news. It is, however, questionable whether it has any great significance. The predominant American opinion is that most of the smaller European monarchies are in process of dissolution, and that their disappearance from the political picture is only a matter of time. Be this as it may, it must be admitted that the political developments in Spain have had but little effect, and need not be seriously considered by business America. A romantic glamor surrounds the history of Spain, but it is chiefly of interest to the romanticists, as the business men of the twentieth century realize that the trade of the once important Hispanic world will have to be re-created before its value is re-established.

From the outside, looking in, it does not appear that the economic developments elsewhere in the world have been very important. In the United States the stock market has shown a declining tendency. This has been construed as an indication that trade is not reviving as rapidly as some hoped it would. This may or may not be the case. The future is largely dependent upon America's ability to get a fair and profitable price for this year's crop. The Chairman of the Federal Farm Board is going about the country urging a reduction in acreage that will bring the supply within the limits of the demand. It is, however, doubtful whether his outgivings will have much effect. The farmers of this country are plainly of the opinion that Congress will find a way to take care of them, and they do not seem to be paying much attention to Chairman Stone's speeches.

In the past their business has been a huge gamble, and with confidence in the backing of their senators and representatives they seem inclined to play their present hand out. They are not to be blamed for pursuing this course, and it may be that they will profit by it, as any serious disaster to the growing crops would result in a sharp advance. The outlook, is, in fact, more uncertain than usual, but the denouement may agreeably surprise the American farmer and his friends, and people generally are less apprehensive about it than they were.

As to the policy of the Federal Farm Board, it may be pointed out that Congress will reconvene on the first Monday in December, and that Chairman Stone and his associates are not likely to make any very radical change in policy until then. If the acreage is not reduced a further decline in commodity prices may be threatened, but there is no indication that the farmers have become convinced that permanent prosperity is likely to be a result of reduced production.

In the distributive trade, business is a little less active than it was. Cotton goods are slightly lower, but woolen fabrics and rayon are fairly well maintained. Steel probably is less depressed than its protagonists have been asserting. Copper, after rising one-half cent a pound, has slipped back ¼ cent.

One of the most interesting sectors of the world at present is Russia. The limited and somewhat doubtful information from that country that is published in the American papers leaves one in confusion as to its future, but taken at its face, the news printed certainly indicates that the Soviet authorities are making some progress.

The stock and bond markets have been heavy and not conspicuously active. Railroad securities are lower. The decline is attributed to the fear that the I.C.C. will unnecessarily delay railway consolidation, and that a sharp reduction in earnings will jeopardize the dividends that some properties have hitherto been expected to pay. This may or may not be the case, but it is undoubtedly true that the cost of operating our railroads was increased by the interest payable on the capital investments made during 1928 and 1929. The result may be some temporary deficits, but as against this a great increase in efficiency is expected.

In other lines of industry, the outlook is more or less confusing, but the abundance of money and bank credit is sure to have a sustaining effect upon trade, and if there should be an advance in commodity prices we may see a period of great and profitable activity therein. In this connection a bit of ancient history may be of interest. In 1897 an issue of Lake Shore and Michigan Southern Railroad 3½ per cent 100-year bonds was easily sold at 103½. Call money was in abundant supply at 1 per cent, and time loans were to be had for as little as 2½ per cent. A continuance of low interest rates was prophesied by everyone, and some financial experts predicted that money was not likely to get above 3 per cent per annum for many years to come. But the prophets were wrong. The Northern Pacific corner, which occurred in 1901, made money very difficult to obtain even at high rates, and the panic of 1907 almost dried up the supply.

These facts are recommended to the consideration of those who have legitimate use for borrowed capital. It may be well for them to provide for their requirements without undue delay.

THE BUSINESS WEEK

April 22, 1931

It becomes increasingly clear that the spring stimulus this year has not been sufficient to start business climbing out of the valley. . . . Such as there has been seems to be fading somewhat early. . . . Our index has been sliding off slowly during the past four weeks, but at 78.6% o. normal it still stands somewhat above the low points touched in the past five months, and there is no suggestion that general business is likely to go to lower levels than have been established since last November. . . . The March and early April evidence in employment, textile activity, iron and steel and automobile production, in building and retail trade, encourages the belief that recession has been checked, but not the hope that an upturn will be early or rapid. . . . Recent resistance to further decline in European economic indicators, except for France, suggests the same. . . . Wheat seems slightly stronger, and the banks are adding to their investments, but the continued decline in most commodity markets, the steady sagging of security prices, the relentless liquidation of commercial loans, and the multiplying moratoria and debt defaults all indicate that the deep-seated disease of deflation has not run its course, and is beginning to cut into the complacency and security of creditors. . . . This is encouraging only because it usually cures the complex just before it kills the patient.

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THE WEEKLY PRICE GUIDE . . . .

Rise and Fall of the Market

NON-FERROUS metals appear firmer as to prices this week, than do most of the steel products out of warehouse stocks. Slab zinc is up 0.85c. per lb., to 4.75c. at E. St. Louis; copper wire advanced ¼c. per lb., in New York, Cleveland and Chicago. None of the other raw metals declined, even though slight reductions became effective in scrap brass and lead. Stocks of wire products are ample at warehouses, in exception to the prevailing rule of low reserves. Pipe lines and railroads are back in the market for steel, after having passed through a spell of slow buying. Construction continues to take heavy tonnages, other avenues of consumption remaining quiet.

(All prices as of Apr. 17, 1931)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI:	
Ala. Foundry (Silicon, 1.75@2.25)	$14.69@$15.19
Tenn. Foundry (Silicon, 1.75@2.25)	14.69@ 15.19
NEW YORK:	
Buffalo No. 2 Fdry. (Silicon, 1.75@2.25)	18.25
BIRMINGHAM:	
No. 2 Foundry (Silicon 1.75@2.25)	12.00@13.00
PHILADELPHIA:	
Eastern Pa., No. 2x (Silicon, 2.25@2.75)	17.76
Virginia No. 2 (Silicon, 1.75@2.25)	17 75
Basic	17.75
CHICAGO:	
No. 2 Foundry, Northern (Silicon, 1.75@2.25)	17.50
No. 2 Foundry, Southern	17.01
PITTSBURGH:	
No. 2 Foundry	18.13@18.63
Basic	18.13@18.63
Bessemer	18.63@19.13

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.00
Cleveland	4.75
Cincinnati	4.45
New York	4.75
Chicago	4.50@4.75

STEEL SHEETS—Prices are in cents per lb. for sheets from warehouse stock except at Pittsburgh mill, where prices apply on large lots:

Blue Annealed*	Pittsburgh Mill	Chicago	Cleveland	New York
No. 10	1.90	3.35†	3.00	3.20‡
No. 12	1.95	3.45†	3.10	3.25‡
No. 14	2.05	3.55†	3.20	3.30‡
No. 16	2.15	3.65†	3.30	3.40‡
Black				
Nos. 18 to 20	2.05@2.15	3.60†	3.40	3.30
No. 22	2.20@2.30	3.75†	3.55	3.45
No. 24	2.25@2.35	3.80†	3.60	3.50
No. 26	2.35@2.45	3.90†	3.70	3.60
No. 28	2.50@2.60	4.05†	3.85	3.75
Galvanized				
No. 10	2.15@2.20	3.65†	3.50	3.35
Nos. 12 to 14	2.25@2.30	3.75†	3.60	3.40
No. 16	2.35@2.40	3.85†	3.70	3.50
No. 18	2.45@2.55	4.00†	3.85	3.65
No. 20	2.65@2.70	4.15†	4.00	3.80
No. 22	2.70@2.75	4.20†	4.05	3.85
No. 24	2.85@2.90	4.35†	4.20	4.00
No. 26	3.10@3.15	4.60†	4.35	4.25
No. 28	3.35@3.40	4.85†	4.70	4.50

*Light Plates. †400 to 3,999 lb. ‡1,000 to 3,999 lb., ordered and released for shipment at one time.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. butt..	56.14%	43.6%	53.3%	42.3%	57.3%	44.8%
3½ to 6 in. lap..	52.72%	40.18%	50.8%	37.8%	53.9%	41.4%

List prices on which foregoing discounts apply, are as follows:

Size, Inches	List Price per Foot	—Diameter in Inches— External	Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.275	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.585	2.875	2.469	.203
3	.765	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28
8	2.50	8.625	8.071	.277

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

—Thickness—		—Outside Diameter in Inches—						
		½	⅝	¾	⅞	1	1¼	1½
Inches	B.w.g.	Price per Foot						
.035	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049	18	.17	.18	.19	.20	.21	.23	.25
.065	16	.19	.20	.21	.22	.23	.25	.27
.083	14	.20	.22	.23	.24	.25	.27	.29
.095	13	.21	.23	.25	.26	.27	.29	.31
.109	12	.22	.24	.26	.27	.28	.30	.32
.120 or .125	11	.23	.25	.27	.28	.29	.31	.33
.134	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	7.00	6.00	6.15
Hoop steel	3.55†	4.00	3.65†
Cold rolled strip steel	4.95	6.00	6.10
Floor plates	4.65†	5.00	5.00†
Cold fin., round or hexagon‡	3.40	3.40	3.35
Cold fin., flat or square‡	3.90	3.90	3.85
Structural shapes	2.90†	2.95	3.00†
Soft steel bars and bar shapes	2.90†	2.95	2.90†
Soft steel bands	3.20†	3.20	3.10†
Rivets, structural or boiler	4.25	....	4.00
Tank plates	2.90†	2.90	3.00†
Bar iron (2.75 at mill)	2.90†	3.00	2.90
Drill rod (from list)	65%	55%	60%

*Flat, $\frac{3}{16}$-in. thick by ¾-in. wide. †Minimum, Chicago, 400 lb., New York, 1,000 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse—$\frac{3}{32}$, 8.35c. per lb.; $\frac{1}{8}$, 7.85c. per lb.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse prices in cents per lb. for small lots:

Copper, electrolytic, New York			11.00
Tin, Straits, pigs, New York			28.00
Lead, pigs, E. St. Louis	4.25	New York	5.50
Zinc, slabs, E. St. Louis	4.75	New York	5.50

	New York	Cleveland	Chicago
Antimony, slabs	10.00	10.25	10.75
Copper sheets*	20.37½	19.87½	19.87½
Copper wire*	11.75	11.87½	11.87½
Copper, drawn, round*	18.87½	18.37½	18.37½
Copper tubing*	22.87½	22.37½	22.37½
Brass sheets, high*	17.62½	17.25	17.25
Brass tubing, high*	22.50	22.12½	22.12½
Brass rods, high*	15.87½	15.50	15.50
Brass wire, high*	17.75	17.75	17.75

*Mill, base.

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%†.....	24.00	24.30	23.30
Zinc sheets (casks).....	9.75	11.25	10.36
Solder (½ and ½).....	21.62½	21.50	18@20

Babbitt metal, delivered in case lots, New York, cents per lb.:

Genuine, highest grade.....	44.50
Commercial genuine, intermediate grade.....	33.75
Anti-friction metal, general service.....	29.00
No. 4 babbitt, f.o.b.....	10.00

†F.O.B.

NICKEL AND MONEL METAL—Prices in cents per lb., base, f.o.b. Huntington, W. Va.:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold drawn.....	50.00	40.00
Tubing.....	75.00*	90.00†
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Welded.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars:

	New York	Cleveland	Chicago
Crucible copper.....	7.75	7.75	6.75@ 7.25
Copper, heavy, and wire..	7.00	7.50	6.25@ 6.75
Copper, light, and bottoms	6.00	6.50	5.50@ 6.00
Heavy lead.....	3.10	3.50	2.50@ 3.00
Lead battery plates.....	1.25	2.50	1.75@ 1.87½
Brass, heavy, yellow....	4.00	4.50	4.00@ 4.25
Brass, heavy, red.....	6.50	7.00	5.75@ 6.25
Brass, light.....	3.25	3.25	3.25@ 3.75
No. 1 rod-brass turnings.	4.25	4.50	4.00@ 4.50
Zinc.....	1.25	1.50	1.25@ 1.50

TIN PLATES—Charcoal—Bright—Per box:

"AAA" Grade:	New York	Cleveland	Chicago
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb....	$0.07@$0.11	$....	$0.13
Cotton waste, colored, per lb..	.05½@.09	....	.09
Wiping cloths, colored, per lb...	.10	....	.09
Sal soda, per lb.....	.01¾	.02	.02
Roll sulphur, per lb.....	.028	.03	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.098	.099	.106
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.75	.60	.60
Machine oil, medium-bodied (55 gal. steel bbl.) per gal.....	.33	.36	.24
Belting—Discounts from list:			
Leather—List price, 24c. per lin.ft., per inch of width, for single ply:			
Medium grade.....	30-10%	30-10%	50%
Med. grade, heavy wgt.....	30%	30 -5%	40%
Rubber transmission—List price, 6-in., 6 ply, $1.83 per lin.ft.:			
First grade.....	60-10-10%	50-10%	60%
Second grade.....	70-10%	60- 5%	65%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb.	$0.029	$0.031	$0.0325
Cold fin. shafting....	per lb.	.034	.034	.034
Brass rods.....	per lb.	.1587½	.1587½	.2125
Solder (½ and ½).....	per lb.	.2162½	.22	.28
Cotton waste, white..	per lb.	.07@.11	.13	.13
Disks, aluminum oxide mineral, cloth, No. 1 6-in. dia.....	per 100	4.59	4.59	4.59
Lard cutting oil.....	per gal.	.75	.75	.75
Machine oil.....	per gal.	.33	.33	.33
Belting, leather, medium.....	off list	30–10%	30–10%	30–10%
Machine bolts, up to 1x30 in., full kegs....	off list	65–10%	65–10%	50–10%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper*.....	$6.03	$6.03	$6.03
Emery cloth*.....	25.87	25.87	25.87
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper†.....	2.61	2.61	2.61
Cloth†.....	4.59	4.59	4.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton.....		Connellsville,	2.50
Coke, prompt foundry, per net ton.....		Connellsville,	3.25
White lead, dry.....	100 lb. kegs...	New York,	13.25
White lead, in oil.....	100 lb. kegs...	New York,	13.25
Red lead, dry.....	100 lb. kegs...	New York,	13.25
Red lead, in oil.....	100 lb. kegs...	New York,	14.75

*Less than 3 reams. †Less than 200.

SHOP SUPPLIES

Discounts from list, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	65–10%
Larger, up to 1 x 30-in., full kegs, list less.....	65–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	65–10%
Larger, list less.....	65–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.25
Structural, round head, broken kegs, net.....	5.75
Tank, 7/16-in. dia. and smaller, list less.....	60–10%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	65–10%
Larger, up to 3-in., list less.....	65–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$3.50
Wrought, broken kegs, per 100 lb., list less.....	1.50
Turnbuckles:	
With stub ends, list less.....	20–10%
Without stub ends, list less.....	55%
Chain:	
Proof coil, base, per 100 lb., net.....	$8.50
Cast iron welding flux, per lb., net.....	.35
Bronzing flux, per lb., net.....	.50

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

Calif., San Francisco—L. S. Leavy, Purch. Agt.—will receive bids until April 27 for shop equipment for city school department.

D. C., Washington—A. L. Flint, General Purchasing Officer of the Panama Canal—will receive bids until April 27 for bench grinder, etc.

Mass., Bedford—T. R. Shaw, The Worthen Memorial—tools and equipment for light blacksmith forging.

Mass., Boston — Gerard Electric Co., 101 Pearl St.—metal working machinery, lathes, gas engines, and electric motors.

Mass., Boston—School Committee—will receive bids until April 27 for shop supplies and equipment including sheet metal equipment, battery equipment, welding supplies, etc., for public schools.

Mass., Dorchester (Boston P. O.)—R. Amundsen, 25 Upham St.—bench lathe and equipment.

Mo., Robertson—Bureau of Supplies & Accounts, Navy Dept., Washington, D. C.—will receive bids until April 28 for woodworking machine for Naval Reserve Aviation Base here.

O., Cleveland—City, G. Sowers, 518 City Hall, Comr. of Engineering and Construction—will receive bids until April 30 for pipe testing machine.

O., Cleveland—Smith Engineering Co., 1982 West 74th St., S. H. Smith, Pres. and Gen. Mgr.—production tools to manufacture airplane parts.

O., Columbus—Jones Auto Radiator Co., 74 North 4th St., C. Bowsman, Pres.—machinery and equipment including metal working equipment for building at 130 East Spring St.

Opportunities for Future Business

Alabama—G. E. Lams, Constructing Quartermaster, Barksdale Field, awarded contract for warehouse, garage, shop, etc. $72,622.

Ark., Little Rock—Thompson, Sanders & Ginochhio, 219 Hall Bldg., Archts., will receive bids until April 24 for the construction of a motor transport garage, etc., for Camp Pike Honorary Commission for use of Arkansas State Guard, Camp Pike.

Calif., Oakland—Art Tool & Die Works, 1020 60th St., will build a 1 story, 23 x 90 ft. machine shop at 60th and Idaho Sts. Work will be done by day labor. Noted April 9.

Calif., Oakland—G. E. Wellgren, 1083 Jones Ave., will build a 1 story, 25 x 40 ft. machine shop. Work will be done by day labor.

Conn., New London — Bureau of Yards & Docks, Navy Dept., Washington, D. C., awarded contract for the construction of a Diesel engine laboratory at Naval Submarine Base here. Estimated cost $40,000. Noted April 16.

Conn., Waterbury—Kaplan Bros., 352 East Main St., awarded contract for a 1 story, 50 x 110 ft. auto sales and service station on East Main St. Estimated cost $40,000. Noted April 16.

D. C., Washington—Corp., c/o D. N. Boyd, of Boyd, Abel & Gugert, Otis Bldg., Philadelphia, Pa., Archts., having sketches made for the construction of a market and garage building at H., I., 10th and 11th Sts. N. W. here. Estimated cost $5,000,000. Maturity July 1.

Ill., Belleville — Constructing Quartermaster, Scott Field Army Air Post, is having preliminary plans prepared for the construction of hangars, shops, etc., at Scott Field. Estimated cost $3,117,000.

Ill., Mooseheart—Loyal Order of Moose, c/o J. J. Davis, Dir. General of Supreme Lodge, Washington, D. C., is having preliminary plans prepared for a vocational high school. Estimated cost $1,500,000.

Ind., South Bend—Notre Dame University, C. L. O'Donnell, Pres., had plans prepared for the construction of an engineering building. Estimated cost $500,000. F. W. Kerrick, South Bend, Archt. R. Hattis, 6 North Michigan Ave., Chicago, Ill., Engr.

Md., Baltimore—A-One Mill Work Co., 627 East 28th St., will build addition to plant.

Md., Baltimore—Campbell Metal Window Co., Bush and Hamburg Sts., awarded contract for two factory buildings, 1 story, 24 x 200 ft. and 2 story, 80 x 100 ft.

Mass., Boston—Eastern Smelting & Refining Co., 109 West Brookline St., plans reconstruction of factory recently detroyed by fire. Estimated cost $40,000. Private plans.

Mass., Boston—D. A. Mullin, 18 Tremont St., is receiving bids for the construction of a garage and repair shop at Cambridge and Mayflower Sts. Estimated cost $45,000. M. J. Mastrangelo, 40 Court St., Archt.

Mass., Cambridge (Boston P. O.) — School Commissioners, are having preliminary sketches made for the construction of a technical high school at Broadway, Felton and Cambridge Sts. Estimated cost $1,500,000. R. H. Doane, 60 Batterymarch St., Boston, Archt.

Mass., Holyoke—Dept. of Public Works, will soon award contract for a 3 story, 70 x 230 and 65 x 75 ft. vocational school at Pine, Beech and Franklin Sts. Estimated cost $250,000. G. P. B. Alderman Co., 316 High St., Archts. Bids opened April 21.

Mass., Higham—Town, W. L. Foster, Chn. Bd. of Selectmen, is receiving bids for the construction of a garage, etc. Estimated cost $40,000. L. Foster, 6 Middle St., Archt. Noted Mar. 12.

Mass., Milton — Town, L. B. Flint, Chn., plans the construction of a 2 story, 55 x 95 ft. municipal building, including work shop, etc., on Walnut St. Estimated cost $75,000. Architect not selected.

Mass., Salem—New England Fuel & Transportation Co., 250 Stuart St., Boston, awarded contract for the construction of a coke terminal, including storage silos, garage, office, etc., at Canal St. Ext. Estimated cost $75,000.

Mich., Flint—Michigan School for the Deaf, I. B. Gilbert, Supt., is having plans prepared for the construction of a 2 and 3 story dormitory and shop building. Estimated cost $150,000. MacKenzie & Pratt, Flint, Archts.

Miss., Jackson — Mississippi Match Co., Natchez, awarded contract for the construction of a factory, including two warehouses and five outbuildings. Estimated cost $125,000. Noted Mar. 12.

Mo., St. Louis — Busch-Sulzer Bros. Diesel Engine Co., 3300 South Second St., is having revised plans prepared and will soon take new bids for an 80 x 150 and 80 x 90 ft. shop and foundry. Estimated cost $250,000. W. J. Knight & Co., 903 Wainwright Bldg., Engrs. Noted Mar. 19.

Neb., Omaha — Creighton University, 25th and California Sts., is having preliminary plans prepared for the construction of a 4 story engineering school at 28th and California Sts. Estimated cost $250,000.

N. J., Hasbrouck Heights (br. Hackensack) —A. Cornith c/o Aitken Bros., 270 Terrace Ave., plans the construction of a garage. Estimated cost $150,000. Architect not announced.

N. J., Jersey City—Owner, c/o C. Philowitz, 20 Journal Sq., Archt., plans the construction of a 15 story garage. Estimated cost $500,000.

N. Y., Long Island City — General Bronze Corp., 34-19 10th Ave., will not construct additions to plant, $400,000 to $1,000,000. Project in abeyance. Noted Jan. 15.

N. Y., Brooklyn—Atlantic & Classon Ave. Corp., A. Kaplan, Pres., is receiving bids for a 1 story, 100 x 100 ft. service garage, etc., at Atlantic and Classon Aves. W. A. Lacerenza, 26 Court St., Archt. Noted April 2.

N. Y., Brooklyn—F. Calahrese, 1612 2nd Ave., New York, will receive bids in late fall for the construction of a 1 story, 100 x 110 ft. service garage at Fenimore St. and East Albany Ave. here. Estimated cost $40,000. D. S. Lang, 1860 Broadway, New York, Archt. Noted April 16.

N. Y., Brooklyn—Caspar Realty Co., 6117 4th Ave., is receiving bids for the construction of a 1 story, 100 x 100 ft. service garage at 4th Ave. and 63rd St. Estimated cost $40,000. D. S. Lang, 1860 Broadway, New York, Archt. Noted April 16.

N. Y., Brooklyn—Fire Dept., Municipal Bldg., H. J. Treacy, plans the construction of a repair shop, administration building, etc., here. Estimated cost $2,000,000. Maturity probably late in June.

N. Y., Brooklyn—P. & C. Building Corp., I. Palatnik, Pres., 1630 Carroll St., will build a 1 story, 100 x 140 ft. service garage at East 35th St. and Ave. I. Estimated cost $40,000. H. J. Nurick, 44 Court St., Archt. Work will be done by day labor and separate contracts. Noted April 16.

N. Y., Brooklyn—T.L.E.G. Construction Co., M. Goodman, Pres., 65 Court St., will soon receive bids for the construction of a 1 story, 98 x 100 ft. service garage at Oakland and Box Sts. Estimated cost $40,000. M. Klein, 65 Court St., Archt. Noted April 16.

N. Y., Buffalo—Granger & Co., 135 Scott St., will soon award contract for the construction of a 2 story, 100 x 140 ft. warehouse at Bailey and Clinton Sts. Estimated cost $100,000. G. S. Rider & Co., Marshall Bldg., Cleveland, O., Archts.

N. Y., Elmira—Elmira Foundry Co., subsidiary of General Electric Co., River Rd., Schenectady, awarded contract for a 50 x 160 ft. foundry here. Estimated cost $50,000.

N. Y., Glendale—Gordon Plumbing & Heating Supply Co., plans alterations to storage building and shop at 77th Ave. and 77th St. Estimated cost $40,000. A. Abrams, 102 Melrose Ave., Lynbrook, Archt. Work will probably be done by separate contracts.

N. Y., New York—Eight Hundred Forty Barry St. Corp., 704 East 133rd St., is having sketches made for a 2 story, 110 x 190 ft. garage at Barry St. and Burnet Pl. Estimated cost $250,000. P. H. Murray, 14 West 45th St., Archt.

N. Y., New York—N. Rotholz, 155 East 42nd St., Archt., is receiving bids for the construction of a service garage at 174 Christopher St. for Barrow St. Corp. D. O'Keefe, Pres., 347 Madison Ave. Estimated cost $275,000. Noted April 9.

N. Y., Tonawanda — Lake Erie Engineering Co., 268 Perry St., Buffalo, awarded contract for the construction of a 1 story, 115 x 500 ft. foundry and machine shop on Woodward Ave. Estimated cost $80,000. Noted April 9.

O., Alliance—Machine Steel Castings Co., plans the construction of a 1 story, 40 x 100 ft. factory, also 25 x 30 ft. addition to core room and installation of conveyor system and new moulding machines. Estimated cost $55,000. Private plans.

O., Cleveland—American Multigraph Co., H. C. Osborn, Pres., 1814 East 40th St., plans the construction of a factory. Estimated cost $50,000. Architect not selected.

O., Cleveland—Cleveland Ice Cream Co., D. H. Schlegal, Pres., West 47th St. and Train Ave., awarded contract for the construction of a 1 story, 70 x 150 ft. factory and garage. Estimated cost $40,000.

O., Cleveland — Ohio Carbon Co., J. E. Schunck Secy and Treas., 12508 Berea Rd., is having preliminary plans prepared for addition to factory. Estimated cost $40,000. G. S. Rider Co., Marshall Bldg., Archt. and Engr.

Pa., Philadelphia—S. H. Anderson, 1500 Walnut St., will build a 1 story, 45 x 200 ft. garage and service station at G and Lycoming Sts. I. W. Levin, 1011 Chestnut St., Archt. Work will be done by separate contracts.

Pa., Philadelphia—Barrett & Co., 40 Rector St., New York, N. Y., awarded contract for a group of buildings for coal tar products plant here. Estimated cost $150,000.

Pa., Pittsburgh—Duquesne Warehouse Co., 10th and Penn Sts., subsidiary of Pennsylvania R.R., Broad St. Station, plans the construction of a 10 story, 320 x 560 ft. storage warehouse including bus terminal and garage, etc. Estimated cost $4,000,000. Hunting, Davis & Dunnells, Century Bldg., Archts.

Ont., Brockville—Eugene F. Phillips Electrical Works, Kingston Rd., awarded contract for the construction of a copper road rolling mill. Total estimated cost $225,000.